UNITED STATES TARIFF COMMISSION

SUMMARIES OF TRADE AND TARIFF INFORMATION

Prepared in Terms of the Tariff Schedules of the United States (TSUS)

Schedule 4

Chemicals and Related Products
(In 12 volumes)

VOLUME 6

Organic Chemicals II

TC Publication 284
Washington, D.C.
1969

The Summaries series will consist of 62 volumes. The titles of the volumes previously released are listed inside the back cover of this volume.

Address all communications to
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Washington, D.C. 20436

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FOREWORD

In an address delivered in Boston on May 18, 1917, Frank W. Taussig, distinguished first chairman of the Tariff Commission, delineated the responsibility of the newly established Commission to operate as a source of objective, factual information on tariffs and trade. He stated that the Commission was already preparing a catalog of tariff information--

> designed to have on hand, in compact and simple form, all available data on the growth, development and location of industries affected by the tariff, on the extent of domestic production, on the extent of imports, on the conditions of competition between domestic and foreign products.

The first such report was issued in 1920. Subsequently three series of summaries of tariff information on commodities were published--in 1921, 1929, and 1948-50. The current series, entitled Summaries of Trade and Tariff Information, presents the information in terms of the tariff items provided for in the eight tariff schedules of the Tariff Schedules of the United States (abbreviated to TSUS in these volumes), which on August 31, 1963, replaced the 16 schedules of the Tariff Act of 1930.

Through its professional staff of commodity specialists, economists, lawyers, statisticians, and accountants, the Commission follows the movement of thousands of articles in international commodity trade, and during the years of its existence, has built up a reservoir of knowledge and understanding, not only with respect to imports but also regarding products and their uses, techniques of manufacturing and processing, commercial practices, and markets. Accordingly, the Commission believes that, when completed, the current series of summaries will be the most comprehensive publication of its kind and will present benchmark information that will serve many interests. This project, although encyclopedic, attempts to conform with Chairman Taussig's admonition to be "exhaustive in inquiry, and at the same time brief and discriminating in statement."

This series is being published in 62 volumes of summaries, each volume to be issued as soon as completed. Although the order of publication may not follow the numerical sequence of the items in the TSUS, all items are to be covered. As far as practicable, each volume reflects the most recent developments affecting U.S. foreign trade in the commodities included.

SUMMARIES OF TRADE AND TARIFF INFORMATION

SCHEDULE 4

Volume 6

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INTRODUCTION

Volume 4:6 is the seventh in a series of 12 volumes on the chemicals and related products classified under schedule 4 of the Tariff Schedules of the United States (TSUS) and one of two volumes on non-benzenoid organic compounds, grouped by chemical function.

Volumes 5 and 6 cover those chemicals which are not covered elsewhere in schedule 4 by more specific provisions of use, composition, or derivation. Volume 6 includes summaries on monohydric and polyhydric alcohols, halohydrins, esters, epoxides, ethers, acetals, lactones, halogenated hydrocarbons, hydrocarbons, sulfur compounds, mixtures listed under subparts 2D and 2E, and cellulose compounds listed under subpart B of part 13. Volume 5 covers chemical functions such as nitrogenous compounds, acids, salts, aldehydes, and ketones. The complete list of products covered by summaries in Volume 6 is shown in appendix A to this volume. Those not included here, identified by shading out, are mostly covered in Volume 5. Because many compounds covered in Vols. 5 and 6 are embraced within two or more chemical functions, the chemical groups are arranged so that a compound described in two or more groups is classifiable in the first group in which it is described. The order of precedence of these functional groups is generally that used in naming and indexing chemical compounds by Chemical Abstracts, a publication of the American Chemical Society.

The consumption of the chemical products covered in the summaries contained in this volume is supplied almost exclusively by domestic production, a large portion being derived originally from petroleum or natural gas. Domestic consumption of these products is essentially equal to domestic production since exports and imports are relatively minor.

It is estimated that the total volume of production of the items covered in the summaries in this volume was over 60 billion pounds in 1966, valued at $5.5 billion. The production figure is somewhat overshadowed by the inclusion of about 38 billion pounds of petroleum hydrocarbons, which are used essentially in the manufacture of other products covered in Volumes 5 and 6 of shcedule 4. In addition to the petroleum hydrocarbons mentioned above, large individual items were ethylene dichloride (3.6 billion pounds), methyl alcohol (3.3 billion pounds), vinyl chloride (2.5 billion pounds), and ethylene oxide (2.3 billion pounds).

Total exports of the articles covered in the summaries included in this volume are estimated at $310 million in 1966. Of this amount, about $183 million is composed of individual compounds, and about $127 million of miscellaneous mixtures. The chemicals which were exported in important quantities in 1966 included monohydric and polyhydric alcohols, chlorinated hydrocarbons, and miscellaneous esters

such as acrylics. The chemical mixtures in the export data consist of fungicides, herbicides, and insecticides, antiknock compounds, and lubricating oil additives.

In 1967, the total value of U.S. imports for consumption of the products covered in the summaries included in this volume amounted to about $45 million. The most important products imported included the monohydric and polyhydric alcohols ($14 million), halogenated hydrocarbons ($11.7 million), and miscellaneous esters of organic and inorganic acids ($6.8 million). The principal sources of imports for the products covered in this volume, in order of importance, were Canada ($11.9 million), West Germany ($6.7 million), Italy ($3.8 million), France ($3.6 million), and the United Kingdom ($3.3 million).

Commodity	TSUS item
Butyl alcohols----------	427.74

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Butyl alcohols are important intermediate chemicals. In recent years, the value of annual production has ranged from $69 million to $80 million and that of exports has ranged from $6 million to $14 million. Imports have been negligible or nil.

Description and uses

Butyl alcohols (also known as butanols) contain four carbon atoms and a hydroxyl group which may be arranged in several isomeric forms, all of which are water-white liquids with distinct odors and individual boiling points and freezing points. There are four principal forms: Normal butyl alcohol (n-butanol) $[CH_3(CH_2)_2CH_2OH]$, isobutyl alcohol $[(CH_3)_2CHCH_2OH]$, secondary butyl alcohol $[CH_3CH_2CHOHCH_3]$, and tertiary butyl alcohol $[(CH_3)_2COHCH_3]$. Normal butyl alcohol and isobutyl alcohol are primary alcohols. Mixtures which contain several of the butyl alcohols are also available commercially.

Normal butyl alcohol is commercially the most important butyl alcohol. It is produced synthetically by the reduction of crotonaldehyde or by the oxo process. In producing n-butyl alcohol by the oxo process, propylene is reacted with carbon monoxide and hydrogen to give n-butyraldehyde and isobutyraldehyde. These are separated and reduced to the corresponding alcohols. n-Butyl alcohol has also been produced synthetically in Europe and Japan by a one-step operation (Reppe process) from propylene, carbon monoxide, and water. Production of normal butyl alcohol by the fermentation process has greatly declined in the past 20 years owing to the fluctuating costs of the raw material (blackstrap molasses) and the advent of economical processes for the production of the synthetic alcohol. Production of the synthetic alcohol in the United States exceeded the production of butyl alcohol by fermentation beginning in the early 1950's. Secondary butyl alcohol, the next most important commercial butyl alcohol, is produced by the hydration of 1-butene in the presence of sulfuric acid. The third most important butyl alcohol is isobutyl alcohol, which is produced through the oxidation of propylene (the oxo process). Tertiary butyl alcohol, the least important

of the four forms, is not commercially significant; it is usually obtained by the hydration of isobutylene in the presence of sulfuric acid.

The most important single use for normal butyl alcohol is in the manufacture of normal butyl acetate, which is used mainly as a solvent in lacquer and lacquer enamels. Normal butyl alcohol is also used to produce amino resins, plasticizers, glycol ethers, and herbicides, and as a solvent in the production of surface coating resins and dyes. The major use for isobutyl alcohol is in the production of isobutyl acetate. It is also used in practically all applications which have been mentioned for n-butyl alcohol. Approximately 90 percent of the annual output of secondary butyl alcohol is used in the production of methyl ethyl ketone, which is used as a solvent for lacquers, paint removers, cements, and adhesives. Tertiary butyl alcohol and butyl alcohol mixtures are used chiefly as components of industrial cleaning compounds. Tertiary butyl alcohol is also used as an intermediate in making oil-soluble polyester resin.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.74	Butyl alcohol----------	2.5¢ per lb.	1.2¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced in appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports in 1967, the average ad valorem equivalent for the rate of duty in effect on December 31, 1967 on butyl alcohol was 55.1 percent and was 48.3 percent for the rate in effect on January 1, 1968.

U.S. consumption

Consumption of butyl alcohol depends almost entirely on domestic production, as imports are virtually nonexistent. From 1961 through 1965, annual consumption increased irregularly from 534 million

pounds to 684 million pounds (table 1). Consumption of butyl alcohol for 1966 is not indicated since production data for secondary butyl alcohol and tertiary butyl alcohol can not be included in the total for all butyl alcohols. Consumption of butyl alcohols has increased in recent years in the existing, well established markets. For example, the production of normal butyl acetate, which is the major individual use for normal butyl alcohol, has increased irregularly from 77 million pounds in 1961 to 85 million pounds in 1966, or by 10 percent over a 5-year period.

U.S. producers

There were seven producers of butyl alcohol in 1966. Normal butyl alcohol was produced by all seven producers at 10 plants, including one plant located in Puerto Rico. Secondary butyl alcohol was produced by two of the seven firms at four separate locations, and isobutyl alcohol was produced by five of these firms at seven locations. Tertiary butyl alcohol was produced by only one firm at one location, and two firms reported production of butyl-alcohol mixtures. All but two of the producers made at least two of the butyl alcohols, while one of the companies produced all four isomers.

Among the producers are some of the largest firms in the chemical field, including two major petroleum companies, all of which are highly diversified. The butyl alcohols account for only a small part of the total annual production of these firms, since they also produce a number of other important alcohols such as propyl alcohol, methyl alcohol, and ethyl alcohol, and many other chemicals.

U.S. production

The production of all butyl alcohols increased irregularly from 600 million pounds in 1961 to 828 million pounds in 1965; corresponding statistics are not publishable for 1966 and are not available for 1967 (table 1); however, production of n-butyl alcohol decreased by more than 7 percent in 1966, since it declined from 429 million pounds in 1965 to 397 million pounds in 1966 (table 1). There were two important reasons for this decrease reported by trade sources. First, total exports of butyl alcohol decreased by about 60 million pounds from 1965 to 1966. Second, the demand for 2-ethylhexanol rose rapidly, forcing producers to allocate more of their process capacity to this product. Since production of this material is more profitable than production of butyl alcohol, 2-ethylhexanol gets priority when the demand is there.

Since 1960, when separate statistics became available, normal butyl alcohol has accounted annually for about 45 percent of total

butyl alcohol production. From 1961 through 1966, more than 50 percent of the annual production of all butyl alcohols was used captively by the producing firms. In recent years, internal use of normal butyl alcohol has ranged from 20 percent to 41 percent of its production, while that of isobutyl alcohol, secondary butyl alcohol, and tertiary butyl alcohol (as a group) has ranged from about 75 percent to about 80 percent of their production.

U.S. exports

Normal butyl alcohol and isobutyl alcohol account for the major portion of butyl alcohol exports. From 1961 through 1967, exports of all butyl alcohols ranged from 66 million pounds in 1961 to 143 million pounds in 1965 (table 1). From 1961 through 1965, exports accounted for 8 to 17 percent of the quantity produced, and 26 to 36 percent of the quantity sold.

From 1961 through 1966, the average unit value for the exported butyl alcohols ranged from 8.0 cents a pound in 1966 to 11.8 cents a pound in 1961.

The Netherlands and Belgium have consistently been the principal markets for exports of butyl alcohol (table 2). Exports of butyl alcohol to these two countries ranged from 63 percent of the total quantity of butyl alcohol exports in 1964 to 79 percent in 1966. Canada, Italy, Japan, Mexico, and the U.S.S.R. have also been major markets for butyl alcohol in recent years.

Exports decreased sharply from 143 million pounds in 1965 to 83 million pounds in 1966 and to 75 million pounds in 1967. The decline is due to a decrease in exports to Japan and the U.S.S.R. Japan received exports of 17 million pounds in 1964 but only 517,000 pounds in 1967. The U.S.S.R. received 23 million pounds of butanol in 1965 and none in 1966 or 1967.

U.S. imports

U.S. imports of butyl alcohol during 1961-67 were insignificant (table 1). The largest quantity imported in one year during this period was 1.1 million pounds, valued at $51,000, in 1967, when the United Kingdom was the sole supplier. The last significant imports of butyl alcohol preceded the emergence of large-scale domestic production of synthetic butyl alcohol.

Foreign production and trade

In addition to Japan, the United Kingdom, and West Germany, other industrialized nations of the world probably produce the butyl alcohols; however, since the advent of synthetically produced butyl alcohol in the United States, this country has become a net supplier to other countries.

Table 1.--Butyl alcohol: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1961-67

Year	Production		Imports	Exports	Apparent consumption
	All butyl alcohols 1/	n-butyl alcohol			
	Quantity (1,000 pounds)				
1961	599,693	283,278	3	65,746	533,950
1962	625,704	275,922	-	92,528	533,176
1963	640,754	294,608	-	78,490	562,264
1964	799,219	388,540	54	139,046	660,228
1965	827,568	428,807	33	143,438	684,163
1966	2/	396,934	2	82,574	3/
1967	3/	3/	1,120	75,095	3/
	Value (1,000 dollars)				
1961	77,960	36,826	1	7,729	70,232
1962	68,827	33,111	-	9,271	59,556
1963	70,483	32,407	-	7,754	62,729
1964	79,922	38,854	7	13,621	66,308
1965	74,481	38,593	3	12,490	61,994
1966	2/	35,724	3	6,586	3/
1967	3/	3/	51	6,330	3/

1/ The value of production is calculated from the unit value of sales of all butyl alcohols.

2/ Statistics on production of secondary butyl alcohol and tertiary butyl alcohol may not be published. Production of isobutyl and alcohol amounted to 92,918 thousand pounds, valued at 7,433 thousand dollars.

3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Butyl alcohol: U.S. exports of domestic merchandise, by principal markets, 1961-67

Market	1961	1962	1963	1964	1965	1966	1967
	Quantity (1,000 pounds)						
Netherlands	28,123	39,371	26,744	47,630	44,907	44,346	40,227
Belgium	22,893	22,582	25,541	40,310	50,809	20,524	16,737
All other	14,730	30,575	26,205	51,106	47,722	17,704	18,131
Total	65,746	92,528	78,490	139,046	143,438	82,574	75,095
	Value (1,000 dollars)						
Netherlands	2,842	3,632	2,549	4,746	3,209	3,039	2,908
Belgium	2,939	2,137	2,385	3,615	4,309	1,659	1,304
All other	1,948	3,502	2,820	5,260	4,972	1,888	2,118
Total	7,729	9,271	7,754	13,621	12,490	6,586	6,330

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Decyl alcohol	427.84

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Decyl alcohol, an important basic chemical in the domestic industry, is becoming more important in international trade. In 1966 the value of imports was $713,000, equivalent to about 5 percent of the value of domestic production that year. Exports are believed to be about equivalent to imports.

Description and uses

Decyl alcohol is a 10-carbon (C_{10}), liquid alcohol which is also known as decanol. It is commercially available in two isomeric forms--normal and iso. "Isodecanol" is an inaccurate term now in current usage for a commercial mixture of isomeric C_{10} alcohols. Decyl alcohol of vegetable origin is covered in another volume in the summary covering items 490.73 and 490.75.

The oxo process is the most important commercial method for producing decyl alcohol. An olefin (nonene) is reacted with carbon monoxide and hydrogen (synthesis gas) in the presence of a cobalt catalyst at elevated temperatures and pressures. The resulting product is a mixture of aldehydes with one more carbon than the starting olefin contains. The aldehydes are then hydrogenated to the corresponding normal alcohol and iso alcohol. Synthetic normal decyl alcohol is also produced by the Ziegler process from ethylene; however, the normal decyl alcohol thus obtained is in a mixture with normal hexyl alcohol (C_6) and normal octyl alcohol (C_8). Another method for obtaining synthetic normal decyl alcohol is by the reaction of capric aldehyde and glacial acetic acid in the presence of zinc dust. The material produced by this method is pure normal decyl alcohol, which is also obtained from natural sources by the catalytic reduction of coconut-oil fatty acids under high pressure (see preceding reference to items 490.73 and 490.75).

The major end use for both normal decyl and isodecyl alcohol is in the manufacture of plasticizers, which use accounts for more than 50 percent of the annual output of decyl alcohol. Decyl alcohol is

also used as an antifoaming agent and in the manufacture of surface-active agents and perfumes.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.84	Decyl alcohol------	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced in appendix A to this volume. The rate shown above as existing prior to January 1, 1968 remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

Consumption of decyl alcohol increased from an estimated 67 million pounds in 1961 to about 128 million pounds in 1966. The primary reason for the growth has been the increased use of decyl alcohol in the production of the plasticizer diisodecyl phthalate, which now accounts for 50 percent or more of annual consumption. Production of diisodecyl phthalate increased from 48 million pounds in 1961 to 103 million pounds in 1966; in terms of volume of production, it is the third most important individual plasticizer used in this country. Diisodecyl phthalate is less volatile than the two most important plasticizers, di(2-ethylhexyl) phthalate and diiso-octyl phthalate, and this quality probably accounts for its rapid growth.

U.S. producers

In 1966 the decyl alcohols (iso and normal) were produced by eight companies (including one joint venture) at seven plants in Delaware, Louisiana, Ohio, Pennsylvania, Texas, and West Virginia. Six of the eight companies made isodecyl alcohol; none of the firms produced both isomeric forms. The producers of decyl alcohols range from medium size to the largest companies in the chemical industry. All are highly diversified companies which make a variety of chemical

products, including other alcohols. The decyl alcohols are not the major source of income of any of the producing companies.

In 1961, about 28 percent of the decyl alcohols produced were used by the manufacturers in their own operations; in 1966, 41 percent of the isodecyl alcohol produced was used captively. Two of the producers of iso decyl alcohol in 1966 also made diisodecyl phthalate, and probably used most of their isodecyl alcohol production for this purpose.

U.S. production

The production of decyl alcohol increased from 67 million pounds in 1961 to more than 122 million pounds in 1966 (see accompanying table). Isodecyl alcohol is the more important of the two forms and annually accounts for more than 95 percent of the total output. Published statistics for 1966 covered only isodecyl alcohol.

U.S. exports

Trade sources estimate that about 4 million pounds of decyl alcohol--normal and iso--was exported in 1964. This represents about 6 percent of the production of decyl alcohol in that year. Exports are believed to have remained at about this same level in 1965, 1966, and 1967. Canada, the European Economic Community (EEC) countries, and Japan are believed to be the major foreign markets.

U.S. imports

Official import statistics on decyl alcohol are not available for periods prior to August 31, 1963, the effective date of the Tariff Schedules of the United States. U.S. imports increased from 132,000 pounds in 1964 to 7.6 million pounds in 1967 (see accompanying table).

Trade sources report that propylene, a source of the nonene used in the oxo process for making decyl alcohol, is more economically available for use in petrochemical operations in Western Europe than in the United States. Because there is more of it available for sale, propylene reportedly sells on the open market for 1.5 cents a pound in Europe, compared with 3 or 4 cents a pound in the United States. Instances have been cited of imported decyl alcohol being sold in the United States at the same price as, or even less than, the domestic alcohol, even after the duty has been paid.

Since 1964, the principal sources for decyl alcohol imports have been Belgium, France, Japan, the United Kingdom, and West Germany.

Foreign production and trade

Decyl alcohol is reported to be produced in Canada and Switzerland, in addition to the EEC countries, the United Kingdom, and Japan.

Decyl alcohol: U.S. production and imports for consumption, 1961-67

Year	Production 1/	Imports
	Quantity (1,000 pounds)	
1961	67,193	2/
1962	55,936	2/
1963	59,278	3/
1964	64,720	132
1965	105,942	1,229
1966	4/ 122,143	6,211
1967	2/	7,623
	Value (1,000 dollars)	
1961	12,095	2/
1962	7,831	2/
1963	7,113	3/
1964	7,119	13
1965	12,713	128
1966	4/ 14,657	713
1967	2/	888

1/ Value of production computed from unit value of sales.
2/ Not available.
3/ Available for last third of 1963 only; no imports were reported.
4/ Data published for isodecyl alcohol only.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Export statistics are not separately available.

Commodity	TSUS item
Ethyl alcohol for nonbeverage purposes-----	427.88

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Ethyl alcohol is a very important organic chemical in the domestic industry and a significant item of world trade. In 1966 the value of U.S. production exceeded $113 million.

Description and uses

Ethyl alcohol, also known as ethanol or grain alcohol, is a clear, colorless, highly flammable liquid with an ethereal odor. Most ethyl alcohol used for nonbeverage or industrial purposes is denatured by the addition of chemicals or mixtures specified by the U.S. Government to make it completely unsuitable for human consumption and to prevent recovery of the pure alcohol from the mixture. In the United States, there are two types of denatured alcohol--completely denatured alcohol and specially denatured alcohol. The former is ethyl alcohol which has been rendered completely unfit for beverage use by the addition of denaturants prescribed by the Federal Government; this type can be sold without permit or bond. Specially denatured alcohol is ethyl alcohol which is treated with denaturants that permit its use for more purposes than completely denatured alcohol, and its sale and use are subject to Federal permit and bond. Specially denatured alcohol has accounted for more than 95 percent of the annual consumption of industrial ethyl alcohol in recent years. The most popular specially denatured alcohol formula is SD-29, which is prepared by adding 5 gallons of a denaturant to 100 gallons of ethyl alcohol. Several chemicals are approved as denaturants for SD-29, including acetaldehyde, ethyl propionate, and ethyl amines. In recent years, SD-29 has accounted for more than half of the annual consumption of all specially denatured alcohol.

Synthetic ethyl alcohol presently accounts for about 95 percent of the annual domestic production of all ethyl alcohol used for industrial purposes. It is produced from ethylene by direct catalytic hydration or by means of ethyl sulfate as an intermediate material; a small amount is also produced as a byproduct in the production of

cellulose compounds and in methanol synthesis. Synthetic ethyl alcohol is not used for beverage purposes. Natural ethyl alcohol produced by the fermentation of molasses, grains, sulphite pulp, and other substances containing carbohydrates accounted for about 5 percent of the ethyl alcohol used in industrial applications in recent years.

Industrial ethyl alcohol is generally sold at 190 proof (95 percent alcohol by volume). A gallon of industrial ethyl alcohol at this proof is referred to by the Internal Revenue Service as a wine gallon (6.8 pounds of alcohol per gallon), and all quantity data in this summary are given on this basis.

Ethyl alcohol for beverage purposes is covered by the summary relating to items 168.30 and 168.31 (suspended).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969 are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.88	Ethyl alcohol for nonbeverage purposes.	6¢ per gal.	3¢ per gal.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on ethyl alcohol was 19.9 percent; it was 17.9 percent for the rate in effect on January 1, 1968.

Ethyl alcohol imported for industrial use is free from excise tax (Internal Revenue Code, Sec. 5311) as is denatured ethyl alcohol (Internal Revenue Code, Sec. 5310(a)).

U.S. consumption

U.S. consumption of synthetic industrial ethyl alcohol increased irregularly from 262 million gallons in 1961 to 293 million gallons in 1966 (table 1). These figures would be up to 5 percent larger if data for fermentation ethyl alcohol were included.

Trade sources indicate that in 1966 about 36 percent of the domestic industrial ethyl alcohol produced was consumed in the manufacture of acetaldehyde, compared with 50 percent in 1964; about 27 percent was used in miscellaneous chemical synthesis, compared with 21 percent in 1964; and about 36 percent was consumed in solvent uses, compared with 29 percent in 1964. The increased consumption in solvent applications and miscellaneous chemical synthesis is helping to compensate for the loss of the acetaldehyde market; acetaldehyde can now be produced more economically directly from ethylene or other hydrocarbons.

Consumption of ethyl alcohol can also be adversely affected indirectly by the development of new methods for manufacturing products now made from acetaldehyde. Butyl alcohol (item 427.74) and 2-ethylhexanol (item 427.98), the manufacture of which now accounts for about 41 percent of the annual consumption of acetaldehyde, are also being made commercially by the oxo process, which does not require acetaldehyde. Acetic acid and acetic anhydride (which account for about 43 percent of acetaldehyde consumption) can also be made economically from other raw materials.

U.S. producers

In 1966 there were eight companies producing industrial ethyl alcohol in nine plants. Four plants were situated in Texas; two, in West Virginia; and one each, in Illinois, Louisiana, and Virginia. The producers of synthetic ethyl alcohol are among the largest firms in the chemical industry and all produce a wide range of chemicals, including other alcohols. Ethyl alcohol and the products made from it probably account for a substantial, but not the major, share of the annual sales of five of the eight ethyl alcohol producers.

At least five of the producers use part or all of their annual production of ethyl alcohol in the manufacture of other products such as chloroethane, ethyl acetate, and acetaldehyde. The captive use of snythetic ethyl alcohol exceeded 35 percent of production in the years 1961 through 1966.

Trade sources report that there were four producers of fermentation ethyl alcohol for industrial purposes in 1967. These

companies had plants in Indiana, Iowa, Louisiana (two plants), Pennsylvania, and Washington.

U.S. production

Production of synthetic ethyl alcohol increased irregularly from 248 million gallons in 1961 to 277 million gallons in 1966. Highest production during this period was in 1964, when 305 million gallons was reported (table 1). Official production statistics from the Internal Revenue Service for industrial fermentation ethanol are available only for 1958, 1959, and 1960; during this period, annual production declined from 38.5 million gallons to 25.0 million gallons. These data on fermentation alcohol are given on a fiscal-year basis (i.e., July 1 to June 30). Trade estimates indicate that 20 million to 35 million gallons of industrial fermentation ethyl alcohol was produced annually in 1961 and 1962, but no more than 10 million to 15 million gallons a year has been produced since 1962.

Since about 1950 the trend in production of ethyl alcohol has been toward the synthetic process. Sharp variations in the prices of the raw materials, such as molasses and grain, used in the production of fermentation alcohol have probably contributed to this trend. Corn can also be used as a raw material for production of fermentation ethyl alcohol, but it is uneconomical because of the high support price maintained by the U.S. Government.

U.S. exports

U.S. exports of ethyl alcohol were 5.8 million gallons in 1961 and 4.8 million gallons in 1967, but substantial fluctuations occured during these years (table 1). For example, exports accounted for less than one-tenth of 1 percent of domestic production in 1962, compared with more than 5 percent in 1963 and 1964. The export value of ethyl alcohol has also fluctuated widely from year to year (from 21 cents per gallon in 1964 to 73 cents per gallon in 1966). The 1968 domestic price of ethyl alcohol delivered in the East is 52 cents per gallon for 190 proof (U.S.P.), tax free, and 7 cents per gallon higher for absolute ethyl alcohol (200 proof).

West Germany and France have alternated in recent years as the prime markets for U.S. exports of ethyl alcohol. In 1963 West Germany received 12.6 million gallons from total exports of 14.8 million gallons, and in 1964 France accounted for 15 million out of 19.2 million gallons (see table 1). Sweden received nearly all (4.3 million gallons) of the 4.9 million gallons exported in 1967.

Many of the industrialized countries of the world still depend on fermentation ethyl alcohol for a large part of their needs for industrial alcohol, and the available supply (and therefore the price) of raw materials, such as molasses, varies from year to year. This probably accounts in part for the sharp fluctuations in U.S. exports.

U.S. imports

U.S. imports of ethyl alcohol fluctuated widely during the period 1961-67, decreasing from 19.9 million gallons in 1961 to 3.0 million gallons in 1964 and rising to 8.0 million gallons in 1967 (table 1). The average foreign value for ethyl alcohol in 1961-67 rose from 21 cents per gallon in 1961 to 39 cents per gallon in 1964 and decreased to 30 cents per gallon in 1967. The latter price is 13 to 20 cents per gallon less than the equivalent price of domestic alcohol but does not include ocean freight or marine insurance, which, if included, would increase the price of the imported alcohol by about 11 percent, exclusive of duty. Much of the duty collected on imports of ethyl alcohol is refunded under drawback on exports of derivatives in which the material is used.

A sharp rise in imports of ethyl alcohol occurred in 1961; in that year imports were at their highest level since 1952 and accounted for more than 7 percent of apparent consumption. The rise has been attributed to the loss of Cuba as a source of blackstrap molasses--the major raw material for industrial ethyl alcohol produced by the fermentation process. As a result of this loss, the major producer of fermentation alcohol for industrial purposes has been required to import substantial quantities of ethyl alcohol to meet its own requirements. Domestic sources helped somewhat to alleviate the raw-material shortage by 1962, and imports of ethyl alcohol in that year declined by more than 15 million gallons from the quantity imported in 1961.

The chief source of ethyl alcohol imports has varied from year to year, but Brazil and Peru have been the two principal sources in recent years (table 2).

Foreign production and trade

Ethyl alcohol is produced in substantial quantities not only in such highly industrialized countries as Canada, Japan, and the nations of the European Economic Community, but also in agriculturally oriented nations such as Brazil and Peru. Although the trend in foreign

countries, especially in Japan and the nations of Western Europe, is now toward production of the synthetic alcohol, a large share of the world's industrial ethyl alcohol is still produced by the fermentation process.

The industrialized nations use most of their ethyl alcohol production domestically, while the agriculturally oriented nations tend to export significant quantities of their annual alcohol production.

Table 1.--Ethyl alcohol for nonbeverage purposes: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1961-67

Year	Production 1/	Imports	Exports	Apparent consumption
	Quantity (1,000 wine gallons)			
1961	247,833	19,910	5,811	261,932
1962	246,992	4,513	153	251,352
1963	286,858	8,423	14,842	280,440
1964	304,573	2,956	19,160	288,369
1965	299,884	12,125	1,677	310,332
1966	276,658	17,372	661	293,369
1967	2/	8,017	4,853	2/
	Value (1,000 dollars)			
1961	101,612	4,229	2,131	103,710
1962	101,267	1,012	146	102,133
1963	117,612	1,918	5,860	113,670
1964	124,874	1,154	4,059	121,969
1965	122,952	4,013	867	126,098
1966	113,430	4,132	482	117,080
1967	2/	2,420	1,608	2/

1/ Value of production calculated from the unit value of sales; data are for synthetic ethyl alcohol only.

2/ Not available.

Source: Production, compiled from U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Production converted from pounds to wine gallons (95 percent alcohol) at a rate of 6.8 pounds per gallon.

Table 2.--Ethyl alcohol for nonbeverage purposes: U.S. imports for consumption, by principal sources, 1961-67

Source	1961	1962	1963	1964	1965	1966	1967
	Quantity (1,000 gallons)						
Brazil	17,579	-	-	2,956	11,278	9,576	6,561
Peru	2,331	904	2,049	-	847	2,425	1,456
France	-	3,609	5,460	-	-	-	-
Netherlands	-	-	914	-	-	-	-
All other	-	1/	-	-	-	5,371	-
Total	19,910	4,513	8,423	2,956	12,125	17,372	8,017
	Value (1,000 dollars)						
Brazil	3,737	-	-	1,154	3,800	2,124	1,976
Peru	492	192	510	-	213	731	444
France	-	820	1,227	-	-	-	-
Netherlands	-	-	181	-	-	-	-
All other	-	2/	-	-	-	1,277	-
Total	4,229	1,012	1,918	1,154	4,013	4,132	2,420

1/ Less than 500 gallons.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

METHYL ALCOHOL

Commodity	TSUS item
Methyl alcohol----------	427.96

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Methyl alcohol (methanol), an important basic chemical used principally as an intermediate in the manufacture of formaldehyde, is also important in international trade. U.S. production of methanol in 1967 was 3.5 billion pounds. Exports exceeded 69 million pounds in 1967.

Description and uses

Methyl alcohol is a colorless, poisonous liquid with a low boiling point. It is available from either natural or synthetic sources, now chiefly the latter. Natural methyl alcohol, which accounts for only about 1 percent of the total production of methyl alcohol, is derived from the destructive distillation of hardwood. It is used as a denaturant for ethyl alcohol. Under the Treasury Department regulations (26 CFR212.15 -.16), methyl alcohol used for specially denatured formula number 1 must be of natural derivation. Specially denatured formula number 1 is mainly for over-the-counter sales for home use. Because of this ruling, natural methyl alcohol commands a price about three times that of synthetic methyl alcohol.

Synthetic methanol is produced commercially from synthesis gas (carbon monoxide and hydrogen) by a catalytic reaction at high pressure and temperature. Methanol can also be produced under similar reaction conditions by substituting carbon dioxide for carbon monoxide or by the partial oxidation of natural gas and other light hydrocarbons. Methanol can also be obtained as a byproduct in the production of acetylene. A recent development in the United Kingdom now permits the production of synthetic methanol at relatively low temperatures and pressures and makes it practical to produce methanol on a smaller scale than was economically possible by previous methods. The starting material for this new process is a virtually sulfur-free gas (naphtha gas or natural gas plus carbon dioxide).

Synthetic methanol derived from snythesis gas can be produced together with ammonia in an integrated operation, since the raw materials for both are the same and the production facilities are usually interchangeable. Synthetic methanol is used in the manufacture of

formaldehyde, dimethyl terephthalate, methyl amines and halides, and as a solvent, inhibitor, denaturant, and as an antifreeze.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.96	Methyl alcohol----------	15.3¢ per gal.	7.6¢ per gal.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS) through the end of 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on methyl alcohol was 88.1 percent; it was 78.8 percent for the rate in effect on January 1, 1968.

U.S. consumption

Consumption of synthetic methyl alcohol increased from about 1.9 billion pounds in 1961 to about 3.4 billion pounds in 1967. The increase during this period is accounted for mainly by the increased demand for formaldehyde, the manufacture of which accounts for about half of the annual output of methanol. Formaldehyde production during the same period rose from 1.7 billion pounds to 3.7 billion pounds. All but one of the manufacturers of synthetic methanol also produce formaldehyde and, therefore, use much of their output of synthetic methyl alcohol captively. The second most important use for synthetic methanol is as a methylating agent; this use accounts for 25 to 30 percent of the annual consumption of methanol. The two most important derivatives are dimethylamine and dimethyl terephthalate. Consumption of natural methanol, which is generally sold on the open market for denaturing use, seems to have stabilized between 1962 and 1965.

U.S. producers

In 1967, 12 U.S. companies were producing synthetic methyl alcohol at 17 plants in Texas (seven plants), Ohio (two plants), Louisiana (two plants), West Virginia (two plants), Florida (one plant), California (one plant), Missouri (one plant), and Kansas (one plant). These companies range from medium size to among the largest in the chemical industry. In 1966, the producing firms consumed 58 percent of the total domestic output of synthetic methanol, mostly in the production of formaldehyde. In addition to methanol, these firms make other acyclic alcohols as well as a large variety of other organic chemicals.

The Department of Commerce reported that in 1966 there were four companies producing natural methanol at four plants; in Arkansas (one plant), Michigan (one plant), and Tennessee (two plants). These firms range in size from small to large and make a variety of products, not all of which are related to the chemical industry. Several of these companies depend upon nonchemical products for the largest portion of their sales. Nearly all of the natural methanol produced is sold on the open market.

U.S. production

The production of methyl alcohol increased from 2.05 billion pounds in 1961 to 3.45 billion pounds in 1967 (table 1). This growth represents synthetic methyl alcohol production, which increased from 2.04 billion pounds in 1961 to 3.45 billion pounds in 1967, while the production of natural methyl alcohol decreased from 10.6 million pounds in 1961 to 8.8 million pounds in 1965 (table 2).

In May 1968, trade journals listed synthetic methyl alcohol in tank car quantities at a selling price of 25 cents per gallon delivered in the East (about 3.7 cents per pound), 27 cents per gallon delivered in the West (about 4.0 cents per pound), and 30 cents per gallon delivered in the Mountain States (about 4.5 cents per pound). Natural methyl alcohol sold at 85 cents per gallon (freight allowed) (or about 13 cents per pound) from 1961 through 1966, then rose to 90 cents per gallon (about 13.6 cents per pound) in May 1967, and was listed at 95 cents per gallon (about 14.3 cents per pound) in May 1968.

U.S. exports

Exports of methyl alcohol, nearly all of which are believed to be synthetic material, decreased irregularly from 187 million pounds in 1961 to 70 million pounds in 1967 (table 1). The decrease may be attributed to the building of methanol-producing facilities in Europe and Japan. In 1964, however, there was a temporary increase in U.S. exports; in that year, they rose to about 272 million pounds, representing nearly a threefold increase over 1963. The major share of these

exports went to Europe, especially West Germany. It is believed that this surge in exports was due to the conversion of methanol-producing units to ammonia production in the Eastern European nations to meet agricultural requirements; for several years prior to 1964, the Eastern European nations, particularly the U.S.S.R., Poland, and East Germany, had supplied large amounts of methanol to Western Europe. Also, in 1964, some of Japan's methanol-producing plants were damaged by earthquake, and U.S. exports of methanol took the place of some Japanese alcohol in the Asian market. The damaged Japanese plants were again producing methanol in quantity by late 1965 or early 1966. According to trade sources, Western Europe was capable of meeting all its needs by 1968.

From 1961 to 1967, the quantity of exports represented between 2 and 14 percent of production, while the export value represented between 2 and 12 percent of the value of production (table 1). During the same period, the export value for methanol ranged from 25.6 cents per gallon (3.9 cents per pound) in 1964 to 36.8 cents per gallon (5.6 cents per pound) in 1967.

From 1965 through 1967, Argentina, Brazil, Colombia, Italy, Mexico, and West Germany were the major export markets, accounting for more than half the total volume of U.S. methanol exports during those 3 years. Mexico was the principal recipient of methanol exports in 1966 and 1967 and was second only to West Germany in 1965.

U.S. imports

U.S. imports of methyl alcohol during the period 1961-67 were as follows:

Year	Quantity (pounds)	Value
1961	2,700	$300
1962	20,400	2,000
1963	13,600	1,900
1964	8,000	900
1965	3,315	375
1966	111,065,243	2,790,570
1967	14,380,729	376,612

During the period 1961-65, methanol imports were small, amounting to considerably less than one-tenth of 1 percent of domestic production. Except for 2,000 pounds from the United Kingdom, all imports came from Canada during these years. The imported methanol had unit values ranging from 75 cents per gallon (11 cents per pound) to 95 cents per gallon (14 cents per pound) and was very likely all natural methanol.

In 1966 and 1967, however, methanol imports rose sharply; in 1966 they were equivalent to 3.4 percent of production. These imports had average unit values of 16.7 cents per gallon (2.5 cents per pound) and 17.4 cents per gallon (2.6 cents per pound) in 1966 and 1967, respectively, and were all of synthetic methanol. Japan, Belgium, and Italy accounted for most of the 1966 imports; Italy, Japan, and Canada supplied the methanol in 1967. Japan accounted for 75 percent or more of the imports in both 1966 and 1967, and imports from Japan had the lowest unit value in those years--15.9 cents per gallon (2.4 cents per pound) in 1966 and 16.0 cents per gallon (2.4 cents per pound) in 1967. Industry sources report that the imports of synthetic methanol in these 2 years were the result of heavy demand for methanol in the production of formaldehyde and dimethyl terephthalate.

Foreign production and trade

Methyl alcohol is a basic organic chemical and is produced, or can be produced, by nearly every country in the world. In addition to being produced in North America, snythetic methanol is also known to be produced in South America, Austria, France, Great Britain, Italy, Japan, the Netherlands, Norway, Africa, India, and West Germany. Natural methyl alcohol has a high unit value because of the cost of production and, therefore, has a very limited market. It is known to be produced in Canada and in other lumber-producing nations, as well as in the United States. Since both synthetic methyl alcohol and ammonia can be produced from synthesis gas, any plant producing ammonia for fertilizer could convert to the production of methanol. Therefore, European, Asian, or other nations could become self-sufficient in synthetic methanol production and could, if they ever reach the point of having an adequate domestic fertilizer supply, eventually become net exporters. As of 1968, Western European production capacity for methanol is estimated by trade sources to be 580 million gallons per year.

Table 1.--Methyl alcohol: U.S. production and exports of domestic merchandise, 1961-67

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Exports	Ratio (percent) of exports to production
	Quantity		
1961	2,050,429	187,085	9
1962	2,235,962	143,261	6
1963	2,341,572	102,692	4
1964	2,640,362	371,605	14
1965	2,877,336	195,498	7
1966	2/ 3,268,923	52,489	2
1967	3/ 3,454,365	69,791	3
	Value		
1961	62,573	5,216	8
1962	67,869	4,074	6
1963	71,057	3,010	4
1964	80,082	9,527	12
1965	86,828	5,402	6
1966	2/ 98,068	1,725	2
1967	3/ 103,631	2,566	3

1/ Value of production calculated by using the unit value of sales of both snythetic and natural methanol.

2/ Synthetic methanol only; statistics for natural methanol not publishable.

3/ Synthetic methanol only; statistics for natural methanol not available.

Source: Production of synthetic methanol, from U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; production of natural methanol, from official statistics of the U.S. Department of Commerce. Exports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Gallons converted to pounds at a rate of 6.63 pounds of methyl alcohol per gallon. Except for 1966 and 1967, imports of methanol have been negligible (see text).

Table 2.--Methyl alcohol, synthetic and natural: U.S. production and sales, 1961-67

Type and year	Production	Sales		Ratio of sales to production
		Quantity	Value	
	1,000 pounds	1,000 pounds	1,000 dollars	Percent
Synthetic methanol:				
1961	2,039,829	1,155,746	41,564	57
1962	2,228,062	1,122,602	38,213	50
1963	2,333,472	1,059,113	36,323	45
1964	2,631,657	1,497,380	42,683	56
1965	2,868,578	1,395,137	43,881	49
1966	3,268,923	1,373,497	44,776	42
1967	3,454,365	1/	1/	1/
Natural methanol:				
1961	10,000	2/ 11,700	3/ 1,521	100
1962	7,900	8,400	1,092	100
1963	8,100	8,500	1,105	100
1964	8,705	4/	4/	4/
1965	8,758	9,130	80	100
1966	4/	4/	4/	4/
1967	1/	1/	1/	1/

1/ Not available.
2/ Total shipments, including interplant transfers.
3/ Value is f.o.b. plant.
4/ Not publishable.

Source: Production and sales of synthetic methanol, from U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; production and sales of natural methanol, from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Octyl alcohol	427.98

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Octyl alcohols are relatively important basic chemicals in domestic industry, being used largely in the manufacture of plasticizers. Domestic production had an aggregate value of about $50 million in 1966. Imports were equivalent to less than 3 percent of production in that year and to perhaps one-fifth the volume of exports.

Description and uses

Octyl alcohols are liquids, and are available commercially in three isomeric forms: Normal primary octyl alcohol, or 1-octanol; 2-ethyl-1-hexyl alcohol, a branched-chain primary octyl alcohol; normal secondary octyl, or 2-octanol (also referred to as capryl alcohol); and iso-octyl alcohol, or iso-octanol, which is not a pure alcohol but includes any of the isomers and mixtures in which the eight carbon atoms form a branched-chain structural arrangement.

Large amounts of octyl alcohols are made from materials produced by the oxo process, which involves a reaction of an olefin, such as propylene, with synthesis gas (a mixture of carbon monoxide and hydrogen) in the presence of a cobalt catalyst at high temperature and pressure. The resulting product is a mixture of normal and iso forms of an aldehyde with one more carbon atom than the starting olefin. This mixture is then separated and hydrogenated to the corresponding normal and iso alcohols. 2-Ethyl-1-hexyl alcohol is produced commercially by this method and is also obtained from acetaldehyde by an aldol condensation. The starting material for 2-ethyl-1-hexyl alcohol is propylene in the oxo process and ethylene in the aldol condensation. These methods are of nearly equal importance in the commercial production of 2-ethyl-1-hexyl alcohol. Iso-octyl alcohol is made only by the oxo process from the olefin heptene.

Normal primary octyl alcohol is obtained as a byproduct in the production of lauryl alcohol from coconut oil. Normal secondary octyl alcohol is produced by reacting castor oil soap (i.e., sodium ricinoleate) with an excess of sodium hydroxide. (Fatty alcohols of vegetable

origin are discussed in the summary covering items 490.65, 490.73, and 490.75.) The straight-chain normal primary and normal secondary octyl alcohols are also made synthetically from ethylene by the Ziegler process, which uses low pressures and an aluminum alkyl catalyst. The straight-chain octyl alcohols produced by this process are not obtained as pure products but as mixtures with straight-chain hexyl and straight-chain decyl alcohols.

The major end use for 2-ethyl-1-hexyl alcohol and for iso-octyl alcohol is in the manufacture of plasticizers and synthetic lubricants. These markets probably account for about 70 percent of the annual production of both these octyl alcohols. The normal primary and normal secondary octyl alcohols are used in the manufacture of perfumes, cosmetics, plasticizers, antifoam agents, and hydraulic oil; as solvents; and in the synthesis of organic compounds.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
427.98	Octyl alcohol--------	10.5% ad val.	5.0% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

From 1961 through 1966, total U.S. consumption of octyl alcohols increased by about 70 percent. The principal reason for this growth is that the phthalic anhydride esters of 2-ethyl-1-hexyl alcohol and iso-octyl alcohol, di(2-ethylhexyl)phthalate and diiso-octyl phthalate, are the two largest volume domestic plasticizers. In 1966 these two plasticizers accounted for 30 percent of all the plasticizers produced and for about 40 percent of the total of the cyclic plasticizers produced (see separate summary, item 405.40). These two plasticizers are used

almost exclusively in the manufacture of vinyl resins. Vinyl resin production, which has grown rapidly in the past decade, exceeded 2.0 billion pounds in 1966. The continued growth in the use of these two plasticizers and, consequently, in the demand for 2-ethyl-1-hexyl alcohol and iso-octyl alcohol appears to be assured as long as the growth in the use of vinyl resins continues.

Until recently the consumption of normal primary and normal secondary octyl alcohols has been less than 20 million pounds a year. The lack of growth was due principally to the fact that these two alcohols had been derived from natural materials only, which resulted in higher values than those of synthetically derived 2-ethyl-1-hexyl alcohol and iso-octyl alcohol. A reduction in price could lead to increased consumption of the two normal octyl alcohols, whose esters are reported to have better plasticizing properties than those of their corresponding branched alcohols. Since the normal octyl alcohols are now being produced synthetically by the Ziegler process, their prices may become more competitive with those of 2-ethyl-1-hexyl alcohol and iso-octyl alcohol.

U.S. producers

In 1966, iso-octyl alcohol was produced by six companies (including one joint venture) at plants in five States. Two of these plants were situated in Texas; and Delaware, Louisiana, Ohio, and Pennsylvania had one plant each. 2-Ethyl-1-hexyl alcohol was produced in 1966 by five companies at seven establishments in three States and Puerto Rico. Texas had four plants, and Louisiana, West Virginia, and Puerto Rico had one plant each. Two of the firms producing 2-ethyl-1-hexyl alcohol also manufacture iso-octyl alcohol. Normal primary and normal secondary octyl alcohols and mixed normal octyl alcohols were produced by five companies in Ohio, Pennsylvania, Texas, and West Virginia. The producers of octyl alcohols are all large, highly diversified companies that make a variety of chemical products, including other alcohols. No one of the firms derives the major share of its income from the production of octyl alcohols.

From 1961 through 1966, from 20 to 40 percent of the annual total production of octyl alcohols was used by the manufacturers in their own operations. In 1966, captive use of iso-octyl alcohol was only 1 percent, while that of 2-ethyl-1-hexyl alcohol was about 55 percent of production. The reason for the high captive use of 2-ethyl-1-hexyl alcohol is that three of its producers also produce the plasticizer di(2-ethylhexyl) phthalate. Three of the producers of iso-octyl alcohol do not make plasticizers.

U.S. production

From 1961 through 1966 the total U.S. production of octyl alcohols increased by more than 68 percent, with 2-ethyl-1-hexanol and iso-octyl alcohol accounting for the major share of the increase.

Through 1964, production could be published only for iso-octyl alcohol because of the necessity of avoiding disclosure of the operations of individual firms. The statistics for 2-ethyl-1-hexanol for 1965 and 1966 are combined with the data for iso-octyl alcohol in the accompanying table. 2-Ethyl-1-hexanol accounted for 70 percent and 76 percent of the combined production data in 1965 and 1966, respectively, see accompanying table. Production of 2-ethyl-1-hexanol increased from 293 million pounds in 1965 to 319 million pounds in 1966, while production of iso-octyl alcohol decreased from 127 million pounds to 100 million pounds in these years. Statistics on normal primary and normal secondary octyl alcohols are not publishable for the period covered by this summary; however, these two alcohols accounted for considerably less than 10 percent of the total production of octyl alcohols.

U.S. exports

Official statistics are not available for U.S. exports of the octyl alcohols. Trade sources estimate that in recent years exports of iso-octyl alcohol have accounted for about 10 percent of annual domestic production while exports of 2-ethyl-1-hexyl alcohol have accounted for about 15 percent of annual domestic production. No estimates of future exports of the two alcohols were made by these trade sources. It is believed that exports of normal primary and normal secondary octyl alcohols are negligible or nil.

Canada, the European Economic Community, and Japan are believed to be the major markets for U.S. octyl alcohol exports.

U.S. imports

No official statistics are available on U.S. imports of octyl alcohols prior to August 31, 1963, when the TSUS became effective. Imports of octyl alcohols were negligible in 1964, but they increased to almost 12 million pounds, valued at $1.3 million, in 1966; they then dropped to 4.4 million pounds, valued at $500 thousand in 1967. Even in 1966, however, imports were equivalent to less than 3 percent of the total production of octyl alcohols. France, the Netherlands, and the United Kingdom have accounted for nearly all the imports of octyl alcohols, with Canada and West Germany supplying small quantities.

As the United States has an abundant supply of petroleum, the raw materials (i.e., ethylene, heptene, and propylene) used to produce 2-ethyl-1-hexyl alcohol and iso-octyl alcohol, the most important of the octyl alcohols, are readily available. Therefore it is unlikely that synthetic octyl alcohols will be imported in the future in more than minor quantities unless domestic petroleum companies, because of their own requirements for high-octane gasoline, are unable to meet the demand for petrochemical uses.

Foreign production

In addition to production in Canada, France, the Netherlands, the United Kingdom, and West Germany, production of octyl alcohols is reported in the other EEC countries, certain EFTA countries, and Japan.

2-Ethyl-1-hexanol and iso-octyl alcohol: U.S. production and imports for consumption, 1961-67

Year	Production 1/	Imports
	Quantity (1,000 pounds)	
1961	59,324	2/
1962	66,783	2/
1963	64,065	3/ 38
1964	142,042	57
1965	4/ 419,945	8,684
1966	4/ 418,896	11,975
1967	2/	4,441
	Value (1,000 dollars)	
1961	10,085	2/
1962	9,350	2/
1963	7,047	3/ 4
1964	17,045	10
1965	4/ 46,194	824
1966	4/ 47,078	1,338
1967	2/	467

1/ Value of production calculated from unit value of sales.

2/ Not available.

3/ Data available for period beginning Aug. 31, 1963; statistics are for the last third of 1963.

4/ Includes combined statistics for 2-ethyl-1-hexyl and iso-octyl alcohols. Data on 2-ethyl-1-hexyl alcohol not separately publishable for years prior to 1965. Iso-octyl alcohol accounted for 126.7 million pounds (valued at $13.9 million) and 100.0 million pounds (valued at $12.0 million) in 1965 and 1966, respectively.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports compiled from official statistics of the U.S. Department of Commerce.

Note.--Statistics on 1-octanol, 2-octanol, or other octanols may not be published. However, such statistics are insignificant in comparison with the figures for 2-ethyl-1-hexanol and iso-octyl alcohol.

Commodity	TSUS item
Propyl alcohol	428.06

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The value of U.S. production of the alcohols covered by this summary is more than $100 million a year. Imports in 1961-67 were negligible or nil, the duty being equivalent to 90 percent ad valorem. Exports fluctuated but in one year reached a figure equal to 4 percent of production.

Description and uses

Propyl alcohol, also known as propanol, is an important chemical that is available in two forms--the primary, or normal propyl alcohol, and the secondary, or isopropyl alcohol. n-Propyl alcohol is a clear, colorless, nonflammable liquid, and isopropyl alcohol is a clear, colorless, flammable liquid.

n-Propyl alcohol is produced chiefly by the oxidation of a mixture of the hydrocarbons butane and propane. It is also obtained commercially by the oxidation (the oxo process) of its corresponding olefin, propylene, and also as a byproduct in the Fischer-Tropsch synthesis of higher hydrocarbons. Isopropyl alcohol is manufactured by a two-step process: the sulfation of propylene with sulfuric acid, followed by hydrolysis of the isopropyl hydrogen sulfate to isopropyl alcohol.

n-Propyl alcohol, the less important form, is used chiefly in the manufacture of brake fluids. Isopropyl alcohol is an important chemical and accounts for by far the major portion of the annual production of all propyl alcohol. It is used principally as an intermediate in the manufacture of acetone. Besides its primary use in the manufacture of brake fluids, n-propyl alcohol is also used as a solvent and as a chemical intermediate in the manufacture of normal propyl acetate and propionic acid. In addition to its principal use in the manufacture of acetone, isopropyl alcohol is also used as a solvent in lacquers and protective coatings; as a solvent for resins,

gums, and essential oils; in the manufacture of general deicing preparations, glycerine, perfumes, and pharmaceuticals; and as a rubbing alcohol. It is directly competitive with other lower alcohols, such as butyl alcohol and ethyl alcohol (see separate summaries), principally as a solvent for plastics and resins and in mixtures or compounds such as deicing formulations.

n-Propyl alcohol is available at just one strength--presumably as the anhydrous alcohol. Refined isopropyl alcohol is available commercially at strengths of 91 percent or 95 percent and as the anhydrous alcohol.

Production statistics on n-propyl alcohol may not be published because publication would reveal the operations of individual producers. Therefore, all data on production and consumption in this summary relate only to isopropyl alcohol.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.06	Propyl alcohol------	3¢ per lb.	1.5¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on propyl alcohol was 90.1 percent; it was 80.9 percent for the rate in effect on January 1, 1968.

U.S. consumption

U.S. consumption of isopropyl alcohol increased steadily from 1.2 billion pounds in 1961 to 1.7 billion pounds in 1966 (see accompanying table). The major reason for this increase in

consumption was the increased production of acetone, which accounted for about 60 percent of the annual output of isopropyl alcohol. Production of acetone made from isopropyl alcohol increased from 591.4 million pounds (79 percent of total acetone production) in 1961 to 881.0 million pounds (66 percent of total acetone production) in 1966. Isopropyl alcohol now faces competition for its acetone market from cumene.

Cumene is used in the production of phenol, and acetone is a major byproduct of this operation. Trade journals estimate that about 30 percent of the acetone produced in 1966 was obtained from the phenol-from-cumene process. This process is expected to grow in the next few years, thereby further reducing the primary market for isopropyl alcohol.

U.S. producers

Isopropyl alcohol was produced in 1967 by three companies at five plants. Two plants are situated in Texas, and California, Indiana, and Louisiana had one plant each. Normal propyl alcohol is produced by two firms at four locations in Texas and West Virginia, with each State having two plants. Only one company produces both n-propyl alcohol and isopropyl alcohol. The four firms producing propyl alcohol are among the largest in the chemical industry and are highly diversified. In addition to propyl alcohol, they produce a variety of chemicals, including other alcohols.

More than half of the annual production of isopropyl alcohol is used by the producing firms in their own operations, nearly all of this captive isopropyl alcohol being used in the manufacture of acetone. All three producers of isopropyl alcohol also manufacture acetone; only one firm produces acetone which does not make its own isopropyl alcohol. Unlike isopropyl alcohol, n-propyl alcohol is nearly all sold on the open market.

U.S. production

The discussion on U.S. production of propyl alcohol is limited to isopropyl alcohol in order to avoid disclosure of the operations of individual producers of n-propyl alcohol.

Production of isopropyl alcohol increased from 1.2 billion pounds in 1961 to 1.7 billion pounds in 1966, representing an overall increase of 44.2 percent.

U.S. exports

U.S. exports of propyl alcohol, most of which were probably isopropyl alcohol, increased irregularly from 13.9 million pounds in 1961 to 38.0 million pounds in 1967 (see acompanying table). Exports increased sharply to 59.5 million pounds in 1963 and then decreased to 31.1 million pounds in 1964. During the period covered, exports accounted for between 1 and 4 percent of annual U.S. production of isopropyl alcohol (see accompanying table).

From 1961 through 1963, the Netherlands was the principal export market for propyl alcohol. It accounted for 37.7 million pounds (63 percent) of U.S. exports in 1963. Since then, Mexico has become the major export market, having received 10.2 million pounds (33 percent) in 1964, 18.5 million pounds (51 percent) in 1966, and 16.0 million pounds (42 percent) in 1967. Other important markets in recent years have included Belgium, Canada, the Philippines, and Venezuela. These four countries and Mexico accounted for 79 percent of propyl alcohol exports in 1967.

Exports of propyl alcohol had an average unit value of 7.7 cents per pound in 1965, 5.9 cents per pound in 1966, and 7.3 cents per pound in 1967. This compares with domestic values from a May, 1968 trade journal for refined isopropyl alcohol which range from 6.7 cents per pound for 91 percent strength alcohol to 7.3 cents per pound for anhydrous alcohol, delivered, and for propyl alcohol which is listed at 12.5 cents per pound, delivered.

U.S. imports

During the years 1961 through 1966, U.S. imports of propyl alcohol were negligible. Prior to September 1963, import statistics for propyl alcohol were included in a basket classification which also contained hexyl alcohol and mixtures of amyl, butyl, hexyl, and propyl alcohols, or fusel oil, as well as pure amyl alcohol. Separate import statistics on propyl alcohol became available after the TSUS went into effect on August, 31, 1963. Imports of propyl alcohol from September through December 1963 amounted to 350,000 pounds (indicating a rate of importation of less than one-tenth of 1 percent of that of domestic production). The imports, in that period valued at $33,000, came from Canada and had an average value of 9.4 cents per pound. There were no imports of propyl alcohol during 1964 or 1965. In 1966, imports amounted to 39,800 pounds, valued at $3,529. Again the imports came from Canada, and their average value was 8.9 cents per pound. Imports in 1967 came principally from the Netherlands and amounted to 2,279,000 pounds (equivalent to 6 percent of exports), valued at $75,853; with an average value of 3.3 cents per pound.

Foreign production and trade

Propyl alcohol, especially isopropyl alcohol, is produced in all the major industrialized countries of the world, but in smaller quantities than in the United States. For example, Western Europe reportedly has a total annual isopropyl alcohol production capacity of about 1.4 billion pounds a year, which is less than the United States produced in 1967. The United Kingdom is reported to have a production capacity of 504 million pounds a year, the largest in Western Europe; West Germany, 305 million pounds a year; the Netherlands, 291 million pounds a year; France, 224 million pounds a year; and Italy and Spain, each 34 million pounds a year. In addition, isopropyl alcohol is known to be produced commercially in Canada, India, and Japan.

Propyl alcohol: U.S. production, exports of domestic merahandise, and apparent consumption, 1961-67

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Exports 2/	Apparent consumption	Ratio (percent) of exports to production
	Quantity			
1961	1,188,672	13,914	1,174,758	1.1
1962	1,325,585	20,015	1,305,570	1.5
1963	1,465,520	59,513	1,406,007	4.0
1964	1,503,957	31,126	1,472,831	2.1
1965	1,537,988	46,284	1,491,704	3.0
1966	1,714,308	36,239	1,678,109	2.1
1967	3/	37,977	3/	3/
	Value			
1961	71,320	881	70,439	1.2
1962	79,535	1,232	78,303	1.5
1963	87,931	2,873	85,058	3.2
1964	90,237	1,679	88,558	1.8
1965	92,279	3,578	88,701	3.9
1966	102,858	2,130	100,732	2.1
1967	3/	2,786	3/	3/

1/ Figures are for isopropyl alcohol only; values calculated using the unit value of sales.

2/ Export statistics may include figures for n-propyl alcohol as well as isopropyl alcohol.

3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; exports compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Allyl	427.70
Amyl	427.72
Crotonyl	427.82
Fusel oil	427.92
Hexyl	427.94
Propargyl	428.04
Other, not elsewhere enumerated	428.12

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The nonbenzenoid, unsubstituted monohydric alcohols covered in this summary are fairly important to the domestic industry, but they are unimportant in international trade. Domestic production slightly exceeded 339 million pounds in 1966. Exports probably do not exceed 1 to 3 percent of production, while imports of these alcohols were equivalent to about 2 percent of domestic production in 1966.

Description and uses

This summary covers about 40 nonbenzenoid, unsubstituted monohydric alcohols of minor importance, 1/ including allyl, amyl, crotonyl, hexyl, and propargyl alcohols, and fusel oil. The more important monohydric alcohols are covered in separate summaries. They are butyl alcohol (item 427.74); decyl alcohol (item 427.84); ethyl alcohol (for nonbeverage purposes) (item 427.88); methyl alcohol (item 427.96); octyl alcohol (item 427.98); and propyl alcohol (item 428.06). These six alcohols account for about 90 percent of domestic production and imports of all nonbenzenoid, unsubstituted monohydric alcohols.

The alcohols covered in this summary are characterized by the presence of one hydroxyl (OH) group in a molecule which contains only carbon, oxygen, and hydrogen. The only two alcohols covered here that contain another oxygen atom in the molecule are furfuryl alcohol and

1/ The alcohols with a quinoid or benzenoid structure are covered among the benzenoid chemicals (items 401.02 to 407.90), the polyhydric alcohols in items 428.30 to 428.46, and 493.68, the fatty alcohols in items 465.45, 465.50, and 490.65 to 490.75, and ethyl alcohol for beverage purposes in items 168.30 and 168.31.

tetrahydrofurfuryl alcohol. Most of these alcohols exist in the liquid state at normal room temperature. The most important of the specifically named alcohols covered by this summary are the amyl alcohols (item 427.72), which are now commercially available in six distinct isomeric forms as well as in mixtures. Also of importance are some alcohols which are not specifically provided for. They include certain synthetic straight-chain primary alcohols with an even number of carbon atoms ranging from C_2 to C_{20}. These alcohols are available principally as mixtures that range in chain length from 6 to 10 carbon atoms and from 12 to 18 carbon atoms. The three other most important alcohols covered here are furfuryl alcohol, 4-methyl-2-penthanol, and tridecyl alcohol. Tridecyl alcohol is not a pure alcohol but a mixture of isomeric forms of tetramethylnonyl alcohol.

In the past, alcohols were produced commercially only by the fermentation of molasses, grain, fruit, corn, and other products, or by the destructive distillation of hardwoods. In recent years, they have been produced almost entirely by synthesis from derivatives of coal gas, natural gas, or petroleum. There are about 12 commercial methods used to produce the unsubstituted monohydric alcohols. The most important of these methods include the hydration of alkenes, the reduction of aldehydes and ketones, the oxo process, the addition of aldehydes and ketones to acetylene, and a patented process that is based on the conversion of ethylene to trialkylaluminum compounds.

The amyl alcohols are used as intermediates in the manufacture of flotation agents, pharmaceuticals, and plasticizers; as solvents for paints and lacquers; and as a reaction medium in organic synthesis. The principal uses for furfuryl alcohol are its conversion to resins for application as foundry core binders, corrosion-resistant mortars, impregnating solutions, wood adhesives, and carbon binders; it is also used as a solvent for phenolic resins and for dyes. 4-Methyl-2-pentanol is used principally as a solvent in hot and cold lacquer formulations. Both tridecyl alcohol and the C_6 to C_{18} alcohol mixtures are used principally as intermediates in the manufacture of plasticizers and surface-active agents. The other alcohols covered here have many end uses, including the manufacture of plastics, insecticides, pharmaceuticals, detergents, and perfumes.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

	TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	427.70	Allyl alcohol----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
1/	427.72	Amyl alcohol----------	3¢ per lb.	1.5¢ per lb.
	427.82	Crotonyl alcohol-------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
	427.92	Fusel oil--------------	3¢ per lb.	1.5¢ per lb.
	427.94	Hexyl alcohol----------	3¢ per lb.	1.5¢ per lb.
	428.04	Propargyl alcohol------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
	428.12	Unsubstituted monohydric alochols, not elsewhere enumerated.	10.5% ad val.	5% ad val.

1/ In accordance with general 3(f) to schedule XX (Geneva--1967), the rates of duty for this item in the columns headed 1970, 1971, and 1972 in appendix A will become effective unless the European Economic Community and the United Kingdom do not proceed with certain reductions provided for in their respective schedules annexed to the Geneva (1967) Protocol to the GATT. If these two participants do not so proceed, the President shall so proclaim, and the rate of duty in the column headed 1969 will continue in effect unless or until the President proclaims that they have agreed so to proceed. See related footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, parts 3, 4, 5, 7, 8, 9, and 13; schedule 5, part 1; schedule 6, part 2; and schedule 7, parts 2, 9, 12, and 13.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalents of the rates of duty in effect on December 31, 1967, on allyl alcohol, amyl alcohol, crotonyl alcohol, hexyl alcohol, and propargyl alcohol were 24.9 percent, 5.4 percent, 15.7 percent, 31.7 percent,

and 31.2 percent, respectively; the average ad valorem equivalents for the rates in effect on January 1, 1968, were 21.1 percent, 4.4 percent, 13.6 percent, 27.7 percent, and 18.5 percent, respectively. There have been no imports of fusel oil in recent years.

U.S. consumption

U.S. consumption of the unsubstituted monohydric alcohols not elsewhere enumerated increased from about 170 million pounds in 1964 to about 240 million pounds in 1965 and to about 340 million pounds in 1966. Statistics are not available for 1961-63.

Improved technology (i.e., the oxo process) has resulted in a reduction in the cost of production of tridecyl alcohol. This has led to an increase in the share of tridecyl alcohol in established markets, such as surface-active agents, and has opened up new markets in the manufacture of plasticizers. A new patented process resulted in the development of the linear C_6 to C_{18} alcohol mixtures which have substantially penetrated both the detergent and plasticizer markets since 1962. Although not new furfuryl alcohol is consumed in increasingly larger quantities each year mainly because of the unique properties of its polymers in resin applications.

U.S. producers

In 1966 the 44 alcohols covered in this summary were produced by 17 companies, including one joint venture, at about 25 plants situated in the States of California, Delaware, Kentucky, Louisiana, Michigan, Nebraska, New Jersey, New York, Pennsylvania, Tennessee, Texas, and West Virginia. Louisiana, Texas, and West Virginia accounted for 50 percent or more of the total output in 1966.

The producers range from medium in size to some of the largest firms in the chemical industry. They are all highly diversified chemical companies that have operations at more than one domestic location. The alcohols covered in this summary do not account for a major share of the annual sales of any of these firms.

Of the total production of these unsubstituted monohydric alcohols, 35 percent and 20 percent were used captively in 1965 and 1966, respectively. The captive use in 1966 of the C_6 to C_{18} alcohol mixtures, amyl alcohols, furfuryl alcohol, 4-methyl-2-penthanol, and tridecyl alcohol ranged from about 2 percent of production for furfuryl alcohol to about 25 percent of production for the amyl alcohols.

U.S. production

U.S. production in 1966 of unsubstituted monohydric alcohols not elsewhere enumerated exceeded 339 million pounds--which was nearly double the output in 1964 and represented a substantial increase over 1965. The C_6 to C_{18} mixed linear alcohols, amyl alcohols, furfuryl alcohol, 4-methyl-2-penthanol, and tridecyl alcohol accounted for more than 75 percent of the output in both 1965 and 1966. Since 1962 the production of the C_6 to C_{18} alcohol mixtures has increased at a faster annual rate than has the production of any other alcohol covered by this summary, and since 1965 the production of these mixtures has exceeded the individual output of each alcohol covered here.

U.S. exports

Official U.S. export statistics are not available for the nonbenzenoid, unsubstituted monohydric alcohols covered in this summary. However, trade sources estimate that exports presently represent no more than 1 to 3 percent of production. The principal export markets are probably the countries of the European Economic Community and Japan.

U.S. imports

The TSUS became effective on August 31, 1963, and provided coverage for many individual alcohols that previously had not been listed separately. Therefore, import statistics on unsubstituted monohydric alcohols for 1961 through the first 8 months of 1963 are not directly comparable with those of the last 4 months of 1963 and all of 1964-67.

The following is a tabulation of total imports in 1961-67 of the unsubstituted monohydric alcohols not elsewhere enumerated:

Year	Quantity (1,000 pounds)	Value (1,000 dollars)
1961----------	358	50
1962----------	394	75
1963----------	378	77
1964----------	797	142
1965----------	1/ 3,285	518
1966----------	6,970	1,065
1967----------	14,534	2,054

1/ Does not include imports of hexyl alcohol (2,200 pounds), which had a value of more than $24 per pound. This value is about 130 times as great as that of domestic hexyl alcohol (i.e., 18 cents per pound).

Imports of these alcohols have been small in comparison with domestic production. In 1966 they were equivalent to about 2 percent of production.

The alcohols imported in 1967 under the basket category (item 428.12) amounted to 14,194,898 pounds, or about 98 percent of the total covered in this summary. More than 60 percent of the 1967 imports under this item were supplied by West Germany, and more than 30 percent, by the United Kingdom. In 1967 West Germany was also the only supplier of propargyl alcohol (119,400 pounds), hexyl alcohol (164,300 pounds), crotonyl alcohol (1,100 pounds), and allyl alcohol (15,100 pounds). The United Kingdom supplied more than 30,000 pounds of the 38,810 pounds of amyl alcohol imported in 1967. There have been no imports of fusel oil since 1964, when 1,200 pounds, valued at $245, was received from Costa Rica.

HALOHYDRINS

Commodity	TSUS item
Halohydrins:	
Butylene chlorohydrin	428.20
Ethylene chlorohydrin	428.22
Propylene chlorohydrin	428.24
Other	428.26

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Halohydrins are intermediates which are generally consumed in the country in which they are produced and, therefore, are unimportant in international trade. U.S. production of ethylene chlorohydrin exceeded 28 million pounds in 1966; production of other halohydrins was probably much less.

Description and uses

Halohydrins are alcohols (hydrins) containing one or more halogen atoms (chlorine, bromine, fluorine, or iodine). According to the TSUS order of precedence of functions, the classification for halohydrins includes not only simple halohydrins but also those which contain an epoxy, ether, acetal, or lactone function, or sulfur or metallic atoms. The classification does not include halohydrins which contain an acidic, aldehyde, ketone, or ester function or a nitrogen atom (see headnote 1, schedule 4, part 2D of the TSUS).

Halohydrins are derived principally from petroleum and natural gas; less than a dozen--all chlorohydrins--are produced commercially. Ethylene chlorohydrin was formerly produced in large volume as an intermediate for ethylene oxide (item 428.84) but has now been largely displaced in this use by the direct oxidation process for producing ethylene oxide. It is still produced in a smaller volume, however, as an intermediate in the manufacture of medicinals, perfume materials, plastics, and dyes.

Propylene chlorohydrin is produced as an intermediate for propylene oxide (item 428.86) and for propylene glycol and urethane foams but is seldom withdrawn or isolated from the reaction system. It is produced largely in facilities converted from production of ethylene chlorohydrin. Butylene chlorohydrin and other halohydrins are used as solvents and intermediates.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Halohydrins:		
428.20	Butylene chlorohydrin	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
428.22	Ethylene chlorohydrin	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
428.24	Propylene chlorohydrin	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
428.26	Other	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on butylene chlorohydrin (item 428.20) was 91.2 percent; that of the rate in effect on January 1, 1968, was 83.2 percent.

Based on imports entered in 1965, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on propylene chlorohydrin (item 428.24) was 71.0 percent; that of the rate in effect on January 1, 1968, was 64.3 percent.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on other halohydrins (item 428.26) was 19.2 percent; that of the rate in effect on January 1, 1968, was 16.8.

There have been no representative imports of ethylene chlorohydrin (item 428.22) in recent years.

U.S. production, exports, and imports

U.S. production of ethylene chlorohydrin totaled 28.4 million pounds in 1966, but statistics are not available for publication on production, sales, or exports of other halohydrins. Six large U.S. chemical companies--with plants in Kentucky, Louisiana, Michigan, Texas, and West Virginia--manufacture halohydrins for use in their own integrated operations. The propylene chlorohydrin produced is consumed without separation in the manufacture of propylene oxide, which in 1966 totaled more than 710 million pounds, valued at more than $73 million. Other halohydrins are produced in substantially smaller volume. Producers' sales of halohydrins--although small--are nevertheless considerably larger than imports. Exports are probably small or nonexistent.

Statistics on imports of halohydrins are not available for the years prior to 1964. Imports increased from 5,275 pounds, valued at $4,428, in 1964 to 11,688 pounds, valued at $13,700, in 1966 and then to 90,070 pounds, valued at $12,887, in 1967 (see accompanying table). Imports have consisted of butylene chlorohydrin from Portugal and Canada, propylene chlorohydrin from Poland, ethylene chlorohydrin from the United Kingdom, and other halohydrins from West Germany, the United Kingdom, and Japan.

Halohydrins: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (pounds)			
West Germany	5,004	-	200	6,990
United Kingdom	271	888	465	480
Canada	-	-	-	82,600
Japan	-	-	11,023	-
Portugal	-	6,542	-	-
Poland	-	44,092	-	-
Total	5,275	51,522	11,688	90,070
	Value			
West Germany	$2,556	-	$1,025	$4,984
United Kingdom	1,872	$2,283	3,437	4,651
Canada	-	-	-	3,252
Japan	-	-	9,238	-
Portugal	-	2,436	-	-
Poland	-	2,361	-	-
Total	4,428	7,080	13,700	12,887

Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. trade position

U.S. consumption of polyhydric alcohols and their derivatives totaled more than 4 billion pounds, valued at about half a billion dollars, in 1966. Imports during that year totaled 33 million pounds, valued at almost $7 million. Exports were about 8 percent of production.

Description and uses

About a hundred polyhydric alcohols and derivatives are produced commercially and are covered here by six individual summaries. Polyhydric alcohols are compounds which contain more than one hydroxyl or OH group. They include glycols or diols (2 hydroxyls), triols (3 hydroxyls), tetrols (4 hydroxyls), and various polyols. This TSUS classification does not include polyols (generally five or six hydroxyls) derived from saccharides (item 493.68).

The hydroxyl groups are reacted with other chemicals to form many useful derivatives--with acids to form esters and with alcohols to form ethers--and with themselves to form polyglycols or ether glycols. Many individual derivatives consist of assorted groups of alcohols, esters, and/or ethers. Such derivatives are included in the definition of the compounds covered by this statement. Derivatives of polyhydric alcohols and fatty acids, however, are considered separately (items 465.05 to 465.10). Polysaccharides and rare saccharides are also considered separately (items 493.65 to 493.68).

According to the TSUS order of precedence of functions, the classification for polyhydric alcohols and their derivatives also includes those compounds in which a carbon, hydrogen, or oxygen atom has been substituted or replaced by a halogen, sulfur, or metallic atom. The classification does not include any compounds which contain an acid, aldehyde, or ketone function or a nitrogen atom or which are obtained from benzenoid sources, but such compounds are of much less commercial importance than those covered by this summary.

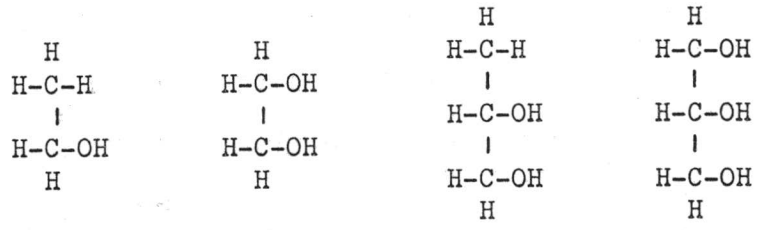
By far the greatest part of the output of polyhydric alcohols and derivatives is obtained from petroleum and natural gas by hydration or condensation of epoxides and aldehydes, in facilities designed essentially for such production. However, the oldest polyhydric alcohol--glycerine--is still obtained largely from natural fats and oils as a byproduct in the production of soaps and fatty acids.

The polyhydric alcohols and the ether alcohols are used both as intermediates and as finished compounds. The esters are used primarily as finished compounds.

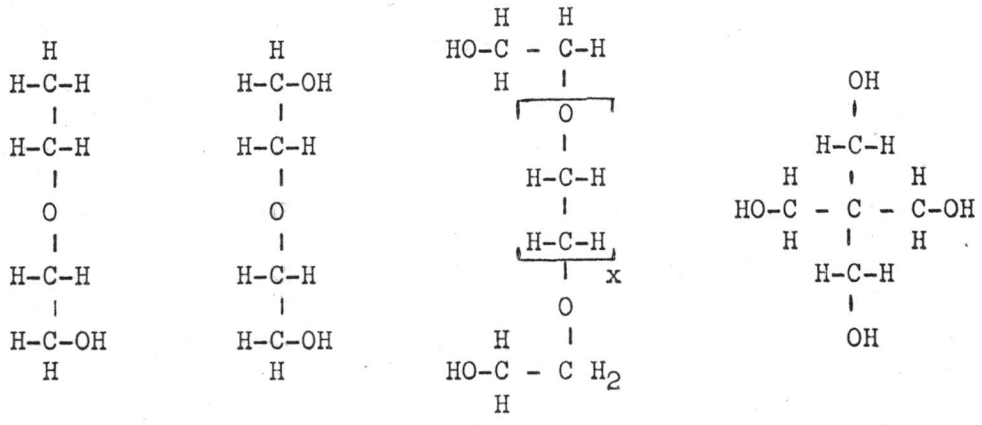
GENERAL STATEMENT ON POLYHYDRIC ALCOHOLS AND THEIR DERIVATIVES

As the hydroxyl groups which distinguish the alcohols resemble the hydroxyl groups which exist in water, they increase the water solubility of the compounds in which they occur. They also offer sites for reactions with other chemicals. The number of hydroxyl groups, their location, and their relationship to the molecular weight contribute to the physical and chemical properties of the compound and, in turn, to the uses for which it is suitable. The polyhydric alcohols are more costly than the monohydric alcohols containing the same number of carbon atoms, but they are generally less volatile, less toxic, less flammable, and more versatile. The polyhydric alcohols derived from petroleum are competitive with glycerine from fats and oils but are less subject to price fluctuations.

The chemical formulas and molecular weights for several related items are shown as follows:



Ethyl alcohol (mol.wt. 46) | Ethylene glycol (mol.wt. 62) | Propylene glycol (mol.wt. 76) | Glycerine (mol.wt. 92)



Ethylene glycol, ethyl ether (mol.wt. 90) | Diethylene glycol (mol.wt. 106) | Polyethylene glycol (mol.wt. 200-6,000) | Pentaerythritol (mol.wt. 136)

GENERAL STATEMENT ON POLYHYDRIC ALCOHOLS AND THEIR DERIVATIVES

Many compounds which contain a high proportion of hydroxyl groups relative to the molecular weight are not only miscible with water in all proportions but also hygroscopic--that is, they can absorb moisture from their surroundings and retain it. Humectants, such as butylene glycol, propylene glycol, glycerine, diethylene glycol, and dipropylene glycol, are used to soften textiles, paper, tobacco, and foodstuffs, to remove moisture from industrial gases, and to moisturize other industrial and household products.

Glycols and several derivatives effectively lower the freezing point of water. Ethylene glycol is used as an antifreeze for automobiles; 1-methoxy-2-propanol is similarly used for trucks; and methoxyethanol is used as a deicing additive for jet fuel. Because of their noncorrosiveness, low volatility, and excellent solvent properties, the compounds, such as ethylene glycol, propylene glycol, and several polyglycols find use in hydraulic brake fluids, liquid heat-exchange media, and other functional fluids.

Many polyhydric alcohols and derivatives are bland chemicals which are soluble both in water and many organic chemicals and oils and have excellent lubricity. With increasing molecular weight, they increase in viscosity, changing from oily liquids to greases and wax-like solids, which are excellent additives and blending agents for a variety of products, such as toilet preparations, pharmaceuticals, printing inks, textile pastes, and lubricants. Glycerine, glycols, and ether alcohols are used individually or in blends with one another.

The chemical reactivity of the hydroxyl groups makes the polyhydric alcohols and derivatives valuable intermediates for plastics and surface-active agents. An increase in the number of hydroxyl groups esterified increases the molecular weight and hardness of the resulting ester. Tetrols, such as pentaerythritol, form alkyd resins which are hard and fast drying, and are used in protective coatings. Triols, such as glycerine, form resins which are slightly less hard. Glycols having high molecular weights form resins which are more flexible. Those having low molecular weights form polymers useful for polyester fibers. Compounds in which the hydroxyl groups have been partially blocked by ether formation or have been reacted with a limited amount of acid are used to make nonionic surface-active agents.

U.S. producers

In 1966 about 40 chemical firms produced synthetic polyhydric alcohols or a derivative. About 50 producers of soaps and fatty acids obtained natural glycerine in very much smaller volume. Large integrated petrochemical firms accounted for the major portion of production.

GENERAL STATEMENT ON POLYHYDRIC ALCOHOLS AND THEIR DERIVATIVES

The two oldest and largest producers of glycols--Dow and Union Carbide--produced the broadest range of products. Together with the two next largest producers--DuPont and Jefferson (a joint venture of American Cyanamid and Texaco) they accounted for about two-thirds of the output of the synthetic compounds. Other large chemical firms produced ethylene glycol and a few other related glycols, and several smaller firms produced a limited volume of specialty compounds, frequently from materials purchased from the larger petrochemical firms. The producers in 1966 are listed by product as shown in the following tabulation:

TSUS item	Commodity	Producer
428.30	1,2(and 1,3)-Butanediol-----	Celanese
	1,4-Butanediol----------	General Aniline
	Propylene glycol----------	Atlas, Chem., Celanese, Dow, duPont, Jefferson, Olin, Union Carbide, Wyandotte.
428.32	Dipentaerythritol and pentaerythritol.	Celanese, Commercial Solvents, Hercules, Reichhold, Tenneco, Trojan.
428.34	Ethylene glycol----------	Allied, Atlas Chem., Calcastieu, Celanese, Dow, duPont, General Aniline, Houston, Jefferson, Olin, Texas Eastman, Union Carbide, Wyandotte.
428.36	Glycerine:	
	Natural----------	About 50 producers of soaps and fatty acids.
	Synthetic----------	Atlas Chem., Dow, Shell.
428.38	Glycerine esters and ethers:	
	Glycerol tri(polyoxypropylene) ethers.	Jefferson, Olin, Union Carbide, Wyandotte.
	Other----------	Armour, Atlas Chem., Eastman Kodak, Glyco, Hall, Shell, Union Carbide.
428.44	Triols and tetrols----------	Atlas Chem., Celanese, Trojan, Union Carbide.
428.46	Other:	
	Diols, other----------	Abbott, ADM, Celanese, Cumberland, Evans, General Aniline, Interchemical, Millmaster Onyx, Nepera, Ott, Shell, Texas Eastman, Union Carbide.

428.46 Other: (Continued)	
Esters----------	Alcolac, Armour, Carlisle, Dow, Drew, duPont, Eastman Kodak, Evans, Hall, Jefferson, Pittsburgh Plate Glass, Roberts, Sartomer, Texas Eastman, Union Carbide.
Ether alcohols----------	Air Reduction, Allied, Ansul, Calcasieu, Dixie Chem., Dow, duPont, Eastman Kodak, General Aniline, Glyco, Houston, Jefferson, Kay-Fries, Nalco, Olin, Pierce, Quaker Oats, Shell, Union Carbide, Wyandotte.

1/ Compiled from the Tariff Commission's annual publication Synthetic Organic Chemicals, United States Production and Sales.

U.S. production and consumption

Apparent U.S. consumption of polyhydric alcohols and their derivatives exceeded 4 billion pounds, valued at half a billion dollars, in 1966, and was supplied almost entirely by production, which in 1966 totaled 4.4 billion pounds (table 1). Of the total production, ethylene glycol supplied 47 percent; other polyhydric alcohols, 25 percent; polyhydric alcohol ethers, 25 percent; and polyhydric alcohol esters, 3 percent. Production of the group has increased steadily--not only through expansion of facilities by older established firms but also by the entry of new producers of ethylene glycol and the diversification of other chemical firms into other glycols and derivatives.

U.S. exports

Statistics are available only for exports of glycerine, ethylene glycol, propylene glycol, polyethylene glycol, and other glycols and ether glycols. These exports--which probably accounted for more than 90 percent of the total exports covered by this general statement--decreased from 350 million pounds, valued at $43 million, in 1965 to 295 million pounds, valued at $40 million, in 1967 (table 2). The decline occurred primarily in exports to industrialized nations--such as the Netherlands, Canada, and Japan--that are expanding their own production facilities, and it was only partially offset by increased exports to less industrialized nations. In 1966, exports ranged from 7 percent of production for ethylene glycol to 12 percent of production for glycerine.

U.S. imports

U.S. imports of polyhydric alcohols and their esters and ethers in 1966 were less than 1 percent of consumption of the group. The most

important items imported were pentaerythritol (11.3 million pounds, valued at $2.1 million), propylene and butylene glycols (7.8 million pounds, valued at $1.8 million), and glycerine (5.5 million pounds, valued at $810,000). Imports of other polyhydric alcohols and derivatives consisted of numerous smaller items and totaled 8.8 million pounds, valued at $2.8 million.

Foreign production and trade

Synthetic polyhydric alcohols and their derivatives are produced both by large petrochemical companies and by smaller chemical concerns in most industrialized countries. Production includes intermediates for polymers and surface-active agents, and compounds for use by pharmaceutical, toilet preparations, food, automotive, and aviation industries.

Several of the larger U.S. producers have subsidiaries, affiliates, or licensees in other countries, such as Belgium, Canada, Italy, Mexico, the Netherlands, Spain, and the United Kingdom. Imports of pentaerythritol from the Canadian affiliate of a U.S. producer have been the only imports of substantial volume from such an affiliate.

Foreign producers, including Belgian, British, Netherlands, French, German, and Japanese also have subsidiaries, affiliates, or licensees in other countries. A U.S. affiliate of a Netherlands petrochemical company is a large producer of petroleum-derived glycerine.

Table 1.--Polyhydric alcohols and their esters and ethers: U.S. production, exports, and imports for consumpton, by selected kinds, 1966

Kind	Production	Exports	Imports
	Quantity (1,000 pounds)		
Grand total	4,416,226	1/306,360	33,435
Polyhydric alcohols, total	3,179,674	2/	2/
Ethylene glycol	2,081,156	146,407	87
Glycerine	354,800	43,385	5,486
Pentaerythritol	80,836	2/	3/11,345
Propylene glycol	258,826	20,361	4/7,815
Triols and tetrols	5/	2/	138
All other	404,056	6/91,765	7/8,557
Polyhydric alcohol esters	134,187	2/	2/
Polyhydric alcohol ethers, Total	1,102,365	2/	2/
Glycerine esters and ethers	8/ 173,896	2/	7
Polyethylene glycol	41,362	4,442	2/
All other	887,107	2/	2/
	Value (1,000 dollars) 9/		
Grand total	569,034	1/41,188	6,923
Polyhydric alcohols, total	365,819	2/	2/
Ethylene glycol	166,492	14,740	62
Glycerine	10/70,000	8,287	810
Pentaerythritol	18,592	2/	3/2,063
Propylene glycol	25,883	2,660	4/1,796
Triols and tetrols	5/	2/	25
All other	84,852	6/14,495	7/2,095
Polyhydric alcohol esters	26,837	2/	2/
Polyhydric alcohol ethers, total	176,378	2/	2/
Glycerine esters and ethers	8/ 31,301	2/	72
Polyethylene glycol	10,027	1,006	2/
All other	135,050	2/	2/

1/Does not include exports of sulfonated polyalcohols, triols (except glycerine), tetrols, or polyhydric esters. It is estimated that such exports would not add more than 10 percent to the total given.

See footnotes at end of table.

Footnotes for table 1--Continued

2/ Not available.
3/ May include some dipentaerythritol.
4/ Includes butylene glycol.
5/ Included with "All other" polyhydric alcohols.
6/ Consists of glycols and glycol ethers.
7/ Includes polyhydric alcohol esters and ethers.
8/ Glycerol tri(polyoxypropylene) ethers only.
9/ Value of production computed from unit value of sales.
10/ Estimated.

Source: Production (except glycerine): U.S. Tariff Commission, Synthetic Organic Chemicals, U.S. Production and Sales; exports, imports, and glycerine production compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Polyhydric alcohols and their ethers: U.S. exports, by principal markets, 1965-67

Market	1965	1966	1967
	Quantity (1,000 pounds)		
Netherlands	170,519	114,184	82,021
Belgium	57,504	58,194	57,859
Canada	33,607	22,780	22,561
Argentina	6,133	11,519	19,170
Brazil	6,975	19,562	20,346
Republic of South Africa	12,858	15,239	17,173
Japan	17,949	14,758	9,785
Mexico	10,720	14,156	10,804
Australia	2,291	3,568	6,485
Spain	1,924	1,652	4,861
Venezuela	2,124	3,712	74
All other	27,052	27,036	39,265
Total	349,658	306,360	295,405
	Value (1,000 dollars)		
Netherlands	19,885	14,486	10,269
Belgium	4,738	4,992	5,434
Canada	4,276	3,819	4,122
Argentina	922	1,658	2,758
Brazil	982	2,448	2,469
Republic of South Africa	2,825	2,622	2,637
Japan	2,417	2,573	1,812
Mexico	1,759	2,219	1,597
Australia	407	675	939
Spain	322	296	779
Venezuela	343	493	703
All other	4,545	4,908	6,650
Total	43,421	41,188	40,169

Note.--Does not include exports of sulfonated polyalcohols, triols (except glycerine), tetrols, or polyhydric esters. It is estimated that such exports would not add more than 10 percent to the totals given.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Butylene glycol and propylene glycol--------	428.30

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of propylene glycol totaled almost 259 million pounds, valued at $25 million, in 1966. Exports amounted to 8 percent of production, and imports were negligible. Trade in butylene glycol is substantially smaller than in propylene glycol.

Description and uses

Butylene glycol is produced in three isomeric forms--1,2-, 1,3-, and 1,4-butanediol. Propylene glycol exists as 1,2- and 1,3- isomers, but only the former is of commercial significance. All are colorless, odorless, tasteless, non-toxic, hygroscopic liquids, which are soluble both in water and in many organic compounds and have a low degree of volatility. Propylene glycol is used principally as an intermediate in the synthesis of polyester resin laminates. It is also widely used as a humectant for cellophane and tobacco, as an intermediate for plasticizers and urethane foams, and as a solvent for toilet preparations, foodstuffs, and pharmaceuticals. Butylene glycols are used for similar purposes but in substantially smaller volume.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.30	Butylene glycol and propylene glycol.	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The

first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on butylene and propylene glycols was 22,6 percent; it was 19.8 percent for the rate in effect on January 1, 1968.

U.S. producers

In 1966 propylene glycol was produced by eight firms at nine plants --three in Texas, two in West Virginia, and the others in Delaware, Kentucky, Louisiana, and Michigan. Most of the producers are large petrochemical companies that produce the intermediate materials for the glycol. All of the producers also make ethylene glycol and other related glycols.

1,2- and 1,3-Butanediol also are produced in Texas in conjunction with propylene glycol. 1,4-Butanediol is produced in Kentucky by a firm that makes ethylene glycol and several unsaturated glycols but does not make propylene glycol.

U.S. production, exports, and imports

U.S. production of propylene glycol increased steadily from 160 million pounds in 1961 to 236 million pounds in 1964. It decreased slightly to 213 million pounds in 1965, then increased to 259 million pounds in 1966 (table 1). In 1966, sales by producers totaled 215 million pounds (83 percent of production), valued at $21.1 million.

U.S. exports of propylene glycol increased rapidly from 12.9 million pounds, valued at $1.9 million, in 1965 to 52.7 million pounds, valued at $5.6 million, in 1967 (table 2) and averaged 7 percent of production in 1965 and 1966. Almost half of the exports in 1967 went to the Netherlands, where several U.S. producers of glycols have affiliates.

Production, sales, and exports of butylene glycols are believed to be considerably smaller than those of propylene glycol.

U.S. imports of butylene and propylene glycols (combined in official statistics) were negligible except in 1966, when they totaled 7.8 million pounds, valued at $1.8 million. Imports in that year came from West Germany and Belgium, and they are believed to have consisted of 1,4-butanediol.

Table 1.--Propylene glycol: U.S. production and sales, 1961-66

Year	Production	Sales	
		Quantity	Value
	1,000 pounds	1,000 pounds	1,000 dollars
1961	160,341	122,141	14,702
1962	184,401	145,160	16,594
1963	199,759	171,172	18,883
1964	236,357	211,454	22,593
1965	212,756	188,933	19,709
1966	258,826	215,480	21,120

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Propylene glycol: U.S. exports of domestic merchandise, by principal markets, 1965-67

Market	1965	1966	1967
	Quantity (1,000 pounds)		
Netherlands	2,145	7,948	25,834
Argentina	477	1,361	3,522
Italy	772	1,784	4,763
Brazil	688	2,580	2,756
Spain	-	-	2,484
Australia	523	469	2,373
Japan	80	137	2,242
Philippines	303	595	805
Republic of South Africa	536	1,257	1,460
All other	1/ 7,422	4,230	6,482
Total	12,946	20,361	52,721
	Value (1,000 dollars)		
Netherlands	225	783	2,426
Argentina	71	174	585
Italy	159	435	406
Brazil	90	254	300
Spain	-	-	296
Australia	66	71	247
Japan	15	35	201
Philippines	56	157	172
Republic of South Africa	67	114	130
All other	1/ 1,176	637	882
Total	1,925	2,660	5,645

1/ Includes 3,306 thousand pounds, valued at 529 thousand dollars, exported to Canada.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Dipentaerythritol and pentaerythritol---	428.32

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of dipentaerythritol and pentaerythritol has increased steadily and in 1966 exceeded 90 million pounds, valued at $20 million. Imports in 1966 accounted for 12 percent of consumption.

Description and uses

Commercial pentaerythritol is a white crystalline solid consisting of a mixture of 80-90 percent (mono-) pentaerythritol and 10-20 percent dipentaerythritol. (Mono-) pentaerythritol is a symmetrical tetrahydric alcohol produced by the alkaline condensation of acetaldehyde and formaldehyde. Dipentaerythritol is a hexahydric ether-alcohol, formed as a coproduct by condensation of two molecules of the monomer. It is seldom isolated and sold separately. Most of the pentaerythritol produced is used as an intermediate in the synthesis of alkyd resins for protective coatings. Lesser amounts are used in the synthesis of pentaerythritol tetranitrate (an explosive) and fatty acid esters used as plasticizers and lubricants.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.32	Dipentaerythritol and pentaerythritol.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate

shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption, production, imports, and exports

Apparent U.S. consumption of pentaerythritol increased steadily and exceeded 90 million pounds in 1966, as shown in the following tabulation: 1/

Year	Production (1,000 pounds)	Imports (1,000 pounds)	Apparent consumption (1,000 pounds)	Ratio of imports to consumption (Percent)
1964--------	69,296	10,780	80,076	13.5
1965--------	69,338	13,844	83,196	16.6
1966--------	80,836	11,345	92,181	12.3

The ratio of imports to consumption decreased from 16.6 percent in 1965 to 12.3 percent in 1966 because a U.S. producer that had formerly imported from a Canadian affiliate began domestic production.

In 1966 six firms of varying sizes produced pentaerythritol at six plants--in Alabama, California, Missouri, New Jersey, Pennsylvania, and Texas. Only one of these firms produced any larger volume, lower priced glycols.

Imports reached a peak of 13.8 million pounds, valued at $2.6 million, in 1965, when they came principally from Canada (see accompanying table). They declined to 6.5 million pounds, valued at $1.1 million, in 1967, when they came principally from Japan and Italy.

No statistics on U.S. exports are available, but exports are probably small.

1/ Production compiled from the Tariff Commission's annual publication, Synthetic Organic Chemicals, United States Production and Sales. Imports compiled from official statistics of the U.S. Department of Commerce.

Dipentaerythritol and pentaerythritol: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Japan	135	2,950	5,448	4,271
Italy	-	755	915	1,829
West Germany	1	1/	-	176
Canada	10,578	10,139	4,982	232
Sweden	66	-	-	-
Total	10,780	13,844	11,345	6,508
	Value (1,000 dollars)			
Japan	24	494	928	725
Italy	-	150	169	307
West Germany	2/	7	2	49
Canada	2,137	1,975	964	48
Sweden	11	-	-	-
Total	2,172	2,626	2,063	1,129

1/ Less than 500 pounds.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Ethylene glycol----------	428.34

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Ethylene glycol contributed more than $150 million to the gross income of the U.S. petrochemical industry in 1966. Although most industrialized countries produce it, the United States imports almost none and is able to export substantial quantities (more than 7 percent of its output in 1966).

Description and uses

Ethylene glycol is a colorless, nonflammable, noncorrosive liquid with a high boiling point and the ability to lower the freezing point of water. By far the greatest part of the ethylene glycol produced is used as an antifreeze in automotive radiators. It is also used as an intermediate for the synthesis of polyester fibers and glycol esters and ethers, and as a solvent, humectant, and hydraulic fluid.

The greatest part of the output of ethylene glycol is produced by the hydration of ethylene oxide (item 428.84) obtained from ethylene. Smaller amounts are produced by the hydration of ethylene oxide obtained from ethylene chlorohydrin (item 428.22), by hydrogenation and hydrogenolysis of a carbohydrate, or from formaldehyde derived from methanol.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.34	Ethylene glycol------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of

trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on ethylene glycol was 20.0 percent; it was 17.5 percent for the rate in effect on January 1, 1968.

U.S. consumption, production, exports, and imports

Total apparent U.S. consumption of ethylene glycol increased each year, except for a small decline in 1964, from 1.1 billion pounds in 1961 to 1.9 billion pounds in 1966 (table 1).

In 1966, U.S. production totaled 2.1 billion pounds, valued at $166 million. In that year ethylene glycol was produced by 12 firms at 19 locations--seven in Texas, three each in Louisiana and West Virginia, and the others in California, Delaware, Indiana, Kentucky, New Jersey, and Puerto Rico. Most of the producers are large petrochemical companies that produce the intermediate materials for ethylene glycol and also produce related glycols, such as propylene glycol, and glycol ethers, such as diethylene glycol, triethylene glycol, and polyethylene glycol.

U.S. exports increased steadily in the early years covered by this summary, reaching a peak of 286 million pounds, valued at $25.5 million, in 1964 (table 2). They then decreased sharply to 81 million pounds, valued at $7.2 million, in 1967 (table 2). The largest decreases were in the exports to Belgium and the Netherlands--where several large U.S. producers have been establishing European affiliates --and were only partially offset by increased exports to countries in the western hemisphere.

U.S. imports have been negligible compared with production, and exports amounted to 68,000 pounds, valued at $40,000, in 1967, coming principally from Switzerland and Japan. The range of unit values of imports indicates that the imports may include either a research quality product or derivatives which have been entered as ethylene glycol when it may have been some other product.

Table 1.--Ethylene glycol: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1958 and 1961-67

(In thousands of pounds)

Year	Production	Imports	Exports	Apparent consumption
1958	1,145,196	1/	51,360	1,093,836
1961	1,183,268	1/	64,905	1,118,363
1962	1,433,859	1/	71,675	1,362,184
1963	1,659,614	28	98,656	1,560,986
1964	1,814,600	27	286,119	1,528,508
1965	1,797,935	78	187,848	1,610,165
1966	2,081,156	87	146,407	1,934,836
1967	1/	68	80,952	1/

1/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Ethylene glycol: U.S. exports of domestic merchandise, by principal markets, 1961 and 1964-67

Market	1961	1964	1965	1966	1967
	Quantity (1,000 pounds)				
Belgium	12,918	87,629	30,470	35,174	23,462
Netherlands	31,936	122,883	121,833	75,486	17,366
Argentina	163	4,562	3,487	5,882	7,510
Brazil	128	2,013	2,180	7,667	7,724
Canada	1,592	23,871	16,697	6,083	5,856
Mexico	1,145	1,602	2,472	4,294	4,568
United Kingdom	-	5,470	-	277	4,826
Venezuela	34	15	667	2,041	2,028
Japan	10,967	27,485	5,048	1,747	-
All other	6,022	10,589	4,994	7,756	7,612
Total	64,905	286,119	187,848	146,407	80,952
	Value (1,000 dollars)				
Belgium	1,186	6,264	1,932	2,540	1,646
Netherlands	4,095	12,394	11,317	8,298	1,301
Argentina	20	751	357	824	994
Brazil	18	223	233	795	768
Canada	176	2,138	1,400	601	647
Mexico	143	186	313	411	496
United Kingdom	-	386	-	32	396
Venezuela	6	2	88	225	249
Japan	939	2,168	470	150	-
All other	599	1,028	508	864	713
Total	7,182	25,540	16,618	14,740	7,210

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Glycerine, crude	428.36
Glycerine, refined	428.38

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The United States produces more than half of the world supply of glycerine and consumes about nine-tenths of its own output. In 1967, U.S. production of glycerine amounted to 366 million pounds. Exports have consisted mainly of refined grades of glycerine. Imports have been small in recent years and during 1962-65 consisted entirely of crude glycerine.

Description and uses

Glycerine is the commercial name for a product which in its pure form is the polyhydric alcohol, glycerol. Glycerine is derived either from natural fats and oils, or by synthesis from petrochemicals (mainly propylene) or carbohydrates. The natural product is obtained in the crude form as a byproduct of the manufacture of soaps, fatty acids, or fatty alcohols. Crude glycerine is refined to a clear, odorless, viscous liquid, ranging in color from colorless to pale yellow and in purity from 95 to 99.5 percent glycerol content, depending on grade. Synthetic glycerine corresponds to the refined natural product and is used interchangeably for most purposes. Refined glycerine is available as chemically pure (C.P.) and U.S. Pharmacopeia (U.S.P.) grades, suitable for use in foods, drugs, pharmaceuticals, and cosmetics; high gravity and yellow distilled grades, for industrial use; and dynamite grade, for explosives.

Glycerine is used in hundreds of products primarily because of its characteristics as a humectant, plasticizer, lubricant, or thickening agent. One or more of these characteristics is utilized in the production of alkyd resins, tobacco products, cellophane, pharmaceuticals, cosmetics, foods and beverages, explosives, textiles, cork products, leather, adhesives, and many other products. Because of its use by so many industries, glycerine is regarded as a good index of business trends.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Glycerine:		
428.36	Crude----------	0.4¢ per lb.	0.2¢ per lb.
428.38	Refined----------	1¢ per lb.	0.5¢ per lb.

The rates effective January 1, 1972, represent the final stage of reductions resulting from concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

For products of the Philippines (which in most years during 1962-67 accounted for a substantial portion of annual imports of glycerine), the current rates of duty are indicated in part C of general headnote 3 mentioned above: For 1967, 40 percent of the column 1 rates, or 0.16 cents per pound for item 428.36; for 1968, 60 percent of the column 1 rates, or 0.21 cents per pound for item 428.36.

Based on imports in 1967, the ad valorem equivalent of the 0.4-cent rate on crude glycerine was 2.3 percent; for imports from the Philippines, which were dutiable at 40 percent of the column 1 rate (0.16 cent per pound), the ad valorem equivalent was 1.4 percent. In 1967 the rate for refined glycerine (item 428.38) was equivalent to 5.4 percent ad valorem; there were no imports of refined glycerine from the Philippines during 1962-67.

U.S. consumption

U.S. consumption of glycerine reached a new peak in 1966, when it amounted to 325 million pounds (table 1), more than 98 percent of which was supplied by U.S. production; consumption decreased slightly in 1967 to 314 million pounds. During the 12 years ending with 1966, the annual domestic consumption of glycerine increased by about 90 million pounds, in three 4-year stages. In 1955-58, the average annual consumption was 238 million pounds; in 1959-62, 265 million pounds; and in 1963-66, 304 million pounds.

The increased consumption of glycerine is attributable mainly to its increased use in pharmaceuticals and toilet goods, foods and beverages, tobacco products, explosives, and urethane foams, which together account for about 50 percent of U.S. glycerine consumption. The alkyd resins industry is the largest individual consumer of glycerine, although it consumed no more in 1966 than the 70 million pounds it consumed in 1961. The cellophane industry, another large consumer of glycerine, in 1966 consumed about 5 million pounds less than the 50 million pounds it consumed in 1961.

Glycerine is competitive for certain uses with other polyhydric alcohols, such as propylene glycol, sorbitol, and pentaerythritol. Generally, each has its preferred uses as long as prices do not change drastically.

U.S. producers

More than 50 U.S. companies produce crude or refined natural glycerine, or both, but glycerine is not the only source of income for any of them. The firms range in size from large chemical or soap companies to small firms of various descriptions, and for many of the latter the sale of glycerine is a more important source of income than for the former. The firms with the largest overall output include the largest glycerine producers.

Most of the companies producing natural glycerine obtain it in crude form from their production of soap or fatty acids. Most of them also refine the crude so obtained; the larger companies, moreover, refine not only the crude which they themselves produce but also substantial quantities purchased from other companies. Several companies produce only refined (natural) glycerine from purchased crude. A few large soap companies account for the bulk of the output of natural glycerine.

Synthetic glycerine is produced by only about four companies, all of them large chemical firms which make a variety of chemicals generally unrelated to glycerine and produced mostly at other locations. No one of these producers accounts for a major share of the total output of synthetic glycerine.

The producers of natural glycerine, both crude and refined, are situated in 25 States, but the largest concentration is in the northeastern part of the country; several are situated in California. Plants producing synthetic glycerine are situated mainly in the Gulf States.

U.S. production

The production of glycerine in the United States increased in each year from 1963 to 1967. After an annual decrease from 279 million pounds in 1961 to 249 million pounds in 1962, production rose to 366 million pounds in 1967 (table 1). In 1961 and 1962 about half of the glycerine produced was made synthetically; in 1965 and 1966 snythetic glycerine accounted for 55 to 60 percent of total glycerine production. Before 1960, natural glycerine accounted for a substantially greater share of annual production. The increasing ratio of synthetic to natural glycerine produced reflects the increasing demand for glycerine that has developed over the years. An expansion in the production of synthetic glycerine has been necessary to meet substantially increased demands inasmuch as the production of lower cost natural glycerine has been restricted by the limited quantities of crude glycerine available from soap and fatty-chemical sources. On the other hand, the production of synthetic glycerine has in the last year or so been restricted by the competition for raw materials. A limited supply of epichlorohydrin, an intermediate common to both glycerine and epoxy resin processes, has prolonged what has been described as a temporary short supply of glycerine.

U.S. exports

Annual U.S. exports of glycerine during 1962-67 ranged from 13 million to 52 million pounds, compared with a range of 10 million to 21 million pounds in the 6-year period 1956-61. Exports reached a record high of 52 million pounds in 1965, decreasing to 43-44 million pounds annually in 1966-67 probably because U.S. production was not able to fulfill all foreign requirements in those years. Statistics on exports of glycerine are reported by the U.S. Department of Commerce on the basis of glycerol content (table 2).

Canada was the leading purchaser of glycerine from the United States in most years suring 1962-67. A large part of the Canadian market was supplied by U.S. glycerine, some of which was in crude form destined for refining in Canada. The Netherlands, the Republic of South Africa, and Japan were other large purchasers of U.S. glycerine during this period (table 2). Exports to the Netherlands and Japan helped to supply the growing general demand for glycerine in those countries, and exports to South Africa served as a raw material for the production of explosives required for its extensive mining operations.

The proportionate amounts of glycerine exports supplied by crude and refined and by natural and synthetic glycerine are not indicated in official U.S. statistics; synthetic glycerine, however, probably

accounted for a substantial share of these exports in the years 1963 through 1967. Most of the glycerine exported during 1962-67 is believed to have been of refined grade.

U.S. imports

During 1962-67, annual U.S. imports of glycerine on a 100-percent-glycerol basis ranged between 2.3 million pounds, valued at $0.2 million, in 1963 and 9.4 million pounds, valued at $1.4 million, in 1964 (table 3). Annual imports for this period averaged 5.6 million pounds, compared with an annual average of 17.0 million pounds for the years 1956-61. In 1962-67 the ratio of imports to consumption ranged between 0.8 percent in 1963 and 3.6 percent in 1962 (table 1); for the previous 6-year period, the ratio of imports to consumption ranged from 4.0 percent in 1959 to 11.0 percent in 1957.

The general decrease over the past decade in U.S. imports of glycerine, most of which was crude glycerine, is attributable to the decrease in world soap production and the competition for the crude glycerine by other countries. Increased U.S. imports of refined glycerine in 1966 were caused by a temporary U.S. shortage of that product (see U.S. production).

In most years during 1962-67 the Philippines was the largest supplier of U.S. imports of glycerine, accounting for 8.1 million pounds in 1962 although it accounted for less than 1 million pounds in 1965; imports from the Philippines in 1966 and 1967 were 2.4 million and 2.2 million pounds. Indonesia and Argentina supplied most of the remainder of the imports in 1962 and 1964, and together they supplied 80 percent of the imports in 1965. Import statistics for glycerine are shown by country in table 3 on an "as is" basis. 1/

Foreign production and trade

Glycerine is an important commodity in world trade because of its use by industrial nations in the manufacture of more than a thousand products. In recent years the trade pattern has shifted from emphasis on shipment of crude natural glycerine from less developed countries to the principal industrial nations toward stress on greater production and exportation of the synthetic product by large producers.

1/ Trade statistics cited in the text are on a 100-percent-glycerol basis, as are the statistics shown in table 1. Official statistics, published by the U.S. Department of Commerce, are on a 100-percent-glycerol basis for exports (table 2) but on an "as is" basis for imports (table 3).

Total foreign consumption of glycerine is equivalent to consumption in the United States. Japan and the countries of Western Europe account for about two-thirds of foreign consumption. In general, foreign production is not able to satisfy foreign requirements although expansion of facilities for producing synthetic glycerine abroad is in progress. Uses for glycerine abroad are similar to those in the United States.

Table 1.--Glycerine: U.S. production, exports of domestic merchandise, imports for consumption, producers' yearend stocks, consumption, and ratio of imports to consumption, 1962-67

(100-percent-glycerol basis)

Year	Production			Exports	Imports 2/	Producers' yearend stocks	Consumption	Ratio of imports to consumption
	Total	Natural 1/	Synthetic 1/					
	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Percent
1962--	249.3	131	118	13.4	9.3	57.5	3/257.0	3.6
1963--	302.1	141	161	30.7	2.3	40.7	290.5	.8
1964--	328.1	150	178	28.1	9.4	61.2	288.9	3.3
1965--	346.5	145	201	52.0	4.2	47.5	312.4	1.3
1966--	354.8	155	200	43.4	4.5	39.0	324.6	1.4
1967--	366.2	4/	4/	43.8	3.6	51.0	314.0	1.1

1/ Estimated by the Soap and Detergent Association.
2/ Estimated; based on "as is" statistics published by the U.S. Department of Commerce (see table 3).
3/ Stocks at beginning of year amounted to 69.3 million pounds.
4/ Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce, except as noted.

Table 2.--Glycerine: U.S. exports of domestic merchandise, by principal markets, 1962-67

Market	1962	1963	1964	1965	1966	1967
	Quantity (1,000 pounds, 100-percent-glycerol basis)					
Canada	5,459	7,189	9,176	10,086	10,640	11,343
Netherlands	2,639	5,018	8,089	10,970	5,113	9,366
Republic of South Africa	69	3,281	5,948	9,953	8,926	7,922
Japan	388	5,941	3,605	7,965	9,347	5,744
Mexico	1,574	2,360	111	2,983	4,918	1,449
West Germany	1,210	988	-	4,450	987	194
United Kingdom	1	3,441	-	3,175	895	108
All other	2,053	2,523	1,215	2,439	2,559	1/ 7,630
Total	13,393	30,741	28,144	52,021	43,385	43,756
	Value (1,000 dollars)					
Canada	885	1,091	1,577	1,592	1,985	2,260
Netherlands	576	943	1,562	2,060	944	1,718
Republic of South Africa	13	552	1,120	2,409	1,744	1,578
Japan	78	1,076	651	1,297	1,771	1,085
Mexico	259	340	23	485	1,043	297
West Germany	138	120	-	545	160	50
United Kingdom	2/	423	-	417	155	24
All other	449	491	431	488	485	1/ 2,214
Total	2,398	5,036	5,364	9,293	8,287	9,226

1/ Includes 1,402 thousand pounds, valued at $431 thousand, to France and 1,185 thousand pounds, valued at $363 thousand, to Poland.

2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Glycerine: U.S. imports for consumption, by principal sources, 1962-67

Source	1962	1963	1964	1965	1966	1967
	Quantity (1,000 pounds)					
Philippines	8,112	2,498	5,456	672	2,412	2,190
Indonesia	1,503	-	2,265	2,054	-	-
Argentina	854	-	2,153	2,043	1,815	-
All other	1,108	399	1,925	463	1/ 1,259	1/ 1,877
Total	11,577	2,897	11,799	5,232	1/ 5,486	1/ 4,067
Total, based on estimated glycerol content	9,300	2,300	9,400	4,200	4,500	3,600
	Value (1,000 dollars)					
Philippines	782	217	665	81	320	311
Indonesia	144	-	209	201	-	-
Argentina	84	-	273	226	230	-
All other	84	30	225	47	1/ 260	1/ 374
Total	1,094	247	1,372	555	1/ 810	1/ 685

1/ Glycerine imports in 1966 and 1967 include some refined glycerine, as follows:

Year	Source						Total
	United Kingdom	Netherlands	Italy	Poland	Canada	Belgium	
	Quantity (1,000 pounds)						
1966	586	181	-	-	31	77	875
1967	664	562	111	110	85	77	1,609
	Value (1,000 dollars)						
1966	132	54	-	-	9	17	212
1967	105	133	25	25	23	17	328

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Glycerine esters and ethers----------	428.40

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of the glycerine esters and ethers considered herein is supplied almost entirely by domestic production, which in 1966 was valued at more than $30 million. U.S. exports are estimated to have accounted for about 5 percent of domestic production; imports have been negligible.

Comment

Less than a dozen glycerine esters and ethers (also known as glycerol or glyceryl esters and ethers) are produced commercially. By far the most important are glycerol tri(polyoxypropylene) ethers, varying in molecular weight from 3,000 to 4,000, which are produced by the reaction of glycerine with propylene oxide and used as intermediates in the synthesis of urethane foams. Other less important esters and ethers are produced by the reaction of glycerine with epoxides, alcohols, and acids and are used as plasticizers, solvents, and intermediates. Glycerine esters and ethers of fatty acids are used as surface-active agents and plasticizers and are provided for under item 465.05 to 465.10.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.40	Glycerine esters and ethers.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative

January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, exports, and imports

In 1966, glycerol tri(polyoxypropylene) ethers were produced by four large chemical companies at plants in Kentucky, Michigan, Texas, and West Virginia. All these producers made the propylene oxide intermediate as well as ethylene and propylene glycols and polyglycols. Other glycerine esters and ethers are produced by five chemical companies of varying sizes.

Statistics on U.S. production and sales of glycerol tri(polyoxypropylene) ethers were first published for the year 1962. Such production and sales have increased since then, as shown in the following tabulation: 1/

Year	Production (1,000 pounds)	Sales	
		Quantity (1,000 pounds)	Value (1,000 dollars)
1962-------	117,304	91,021	19,845
1963-------	134,711	112,500	24,665
1964-------	173,224	157,167	31,841
1965-------	161,250	134,476	25,767
1966-------	173,896	149,250	26,760

Production and sales of other glycerine esters and ethers discussed herein are believed to be considerably smaller than those of glycerol tri(polyoxypropylene).

In recent years, U.S. exports of the items covered by this summary have probably been equivalent to less than 5 percent of annual domestic production. U.S. imports have been small compared with production--only 130,000 pounds, valued at $30,000, in 1967--and have varied considerably as to source, composition, and unit value (see accompanying table).

1/ Compiled from the Tariff Commission's annual publication Synthetic Organic Chemicals, United States Production and Sales.

Glycerine esters and ethers: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (pounds)			
Canada	-	-	-	129,520
Sweden	1,498	-	3,326	-
France	-	6,900	2,651	-
All other	2,205	-	1,511	-
Total	3,703	6,900	7,488	129,520
	Value			
Canada	-	-	-	$30,000
Sweden	$31,050	-	$69,754	-
France	-	$2,927	1,230	-
All other	968	-	672	-
Total	32,018	2,927	71,656	30,000
	Unit value (per pound)			
Canada	-	-	-	$0.23
Sweden	$20.73	-	$20.97	-
France	-	$0.42	.46	-
All other	.44	-	.44	-
Average	8.65	.42	9.57	.23

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Polyalcohols, sulfonated	428.42
Triols and tetrols	428.44
Polyhydric alcohols and derivatives not elsewhere enumerated	428.46

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of polyhydric alcohols and derivatives not elsewhere enumerated was valued at slightly less than $200 million in 1966 and was supplied almost entirely by domestic production.

Description and uses

Polyhydric alcohols and derivatives discussed herein consist of more than 75 compounds of which the most important items are the polymers and ethers of ethylene and propylene glycols. The triols (see also items 428.36 and 428.38), tetrols (see also item 428.32), and sulfonated polyalcohols are of much less commercial significance.

The di- and tri- ethylene and propylene glycols have similar uses--in the dehydration of gases; as solvents for resins, dye-stuffs, and inks; and in hydraulic fluids, plasticizers, and intermediates for surface-active agents and polymers. Their ethers are used as brake fluids, jet fuel deicing additives, and plasticizers, and as solvents in surface coatings. Polypropoxy ethers are intermediates for urethane foams.

Polyethylene glycol varies in molecular weight from 200 to 6,000; it is widely used in bases for toilet preparations and pharmaceuticals. Polypropylene glycol varies in molecular weight from 150 to 2,000 and is used in bases for brake fluids and other functional fluids. In addition, both are used as lubricants, plasticizers, solvents, and intermediates. Other polyhydric alcohols and derivatives have a variety of similar uses in household and industrial products.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Alcohols, polyhydric, and derivatives:		
428.42	Polyalcohols, sulfonated	10.5% ad val.	5% ad val.
428.44	Triols and tetrols	10.5% ad val.	5% ad val.
428.46	Polyhydric alcohols and derivatives not elsewhere enumerated.	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968 remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on other polyhydric alcohols and their derivatives (item 428.46) was 23.3 percent; it was 20.5 percent for the rate in effect on January 1, 1968 (appendix A).

U.S. producers and production

Of the 13 U.S. producers of ethylene glycol, 10 also produce some di-, tri-, or poly-ethylene glycols, but only four produce other glycol ethers. Five of the eight producers of propylene glycol also produce some di- and poly-propylene glycols and polypropoxy ethers. Numerous companies, both large and small, also produce a variety of smaller derivatives.

U.S. production of polyhydric alcohols and derivatives in 1966 exceeded 1.2 billion pounds of which three-fourths was ether glycols and other ethers (table 1). Sales totaled 922 million pounds, valued at $155 million. Production of most of the items in the group increased steadily from 1962 to 1966 (table 2).

U.S. exports

U.S. exports of glycols (other than propylene and ethylene glycols) and ether glycols increased from 97 million pounds, valued at $15.6 million, in 1965 to 118 million pounds, valued at $18.1 million, in 1967. Exports in 1966 were less than 10 percent of production. The principal markets were the Netherlands and Belgium (table 3), in which countries several U.S. producers have affiliates.

U.S. imports

U.S. imports of the compounds discussed here totaled approximately 1 million pounds, valued at about $463,000, in 1964, when they were first published separately (table 4). They increased sharply and averaged 11.7 million pounds, valued at $3.5 million in 1965-67. Canada was the principal source of supply in 1967, and West Germany, in 1964-66. Imports have consisted of numerous polyhydric alcohols and their ether and ester derivatives, including 1,4-butanediol (which is also known as 1,4-butylene glycol and imported under item 428.30). Imports of triols and tetrols totaled 2,504 pounds (all from West Germany), valued at $737, in 1964 and increased to 253,000 pounds (principally from Japan), valued at $174,000, in 1967. Imports of sulfonated polyalcohols have been negligible.

Table 1.--Polyhydric alcohols and derivatives, not elsewhere enumerated: U.S. production and sales, by selected kinds, 1966

Kind	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Polyhydric alcohols (other than ethylene glycol, pentaerythritol, propylene glycol, and sorbitol	404,056	302,599	62,925	$0.21
Polyhydric alcohol esters	134,187	140,767	27,868	.20
Polyhydric alcohol ethers, total	928,469	694,691	110,596	.16
2-Butoxyethanol (Ethylene glycol monobutyl ether)	69,333	64,738	11,164	.17
2-(2-Butoxyethoxy)ethanol (Diethylene glycol monobutyl ether)	-	12,142	3,200	.26
Diethylene glycol	181,942	137,354	13,649	.10
Dipropylene glycol	36,601	34,146	3,849	.11
2-Ethoxyethanol (Ethylene glycol monoethyl ether)	-	49,437	7,842	.16
2-(2-Ethoxyethoxy)ethanol (Diethylene glycol monoethyl ether)	33,916	23,976	4,210	.18
2-[2-(2-Ethoxyethoxy)ethoxy]-ethanol (Triethylene glycol monoethyl ether)	-	3,773	538	.14
2-Methoxyethanol (Ethylene glycol monomethyl ether)	96,264	77,260	12,814	.17
2-(2-Methoxyethoxy)ethanol (Diethylene glycol monomethyl ether)	8,837	-	-	-
2-[2-(2-Methoxyethoxy)ethoxy]-ethanol (Triethylene glycol monomethyl ether)	5,245	-	-	-
1-Methoxy-2-propanol	10,603	-	-	-
Polyethylene glycol	41,362	36,492	8,875	.24
Polypropylene glycol	100,558	86,522	14,147	.16
Triethylene glycol	59,065	49,894	8,307	.17
All other ethers of polyhydric alcohols	284,743	118,957	22,001	.18

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales, 1966, TC Publication 248, 1968.

Table 2.--Polyhydric alcohols and derivatives, not elsewhere enumerated: U.S. production, by selected kinds, 1962-66

Kind	1962	1963	1964	1965	1966
Diethylene glycol	127,047	122,433	151,475	158,746	181,942
Dipropylene glycol	22,928	26,252	27,101	33,904	36,601
2-Ethoxyethanol (Ethylene glycol monoethyl ether) 1/	29,071	33,601	47,216	46,560	49,437
2-(2-Ethoxyethoxy)-ethanol (Diethylene glycol monoethyl ether)	2/	2/	36,294	33,733	33,916
2-[2-(2-Ethoxyethoxy)-ethoxy]-ethanol (Triethylene glycol monoethyl ether)	2/	2/	1/8,277	1/6,933	1/3,773
2-Methoxyethanol (Ethylene glycol monomethyl ether)	2/	67,337	73,376	73,801	96,264
2-(2-Methoxyethoxy) ethanol (Diethylene glycol monomethyl ether)	2/	2/	11,022	11,416	8,837
2-[2-(2-Methoxyethoxy) ethoxy]-ethanol (Triethylene glycol monomethyl ether)	2/	2/	2/	3,128	5,245
Polyethylene glycol	32,843	32,809	39,120	39,698	41,362
Polypropoxy ethers (except from glycerine)	31,777	47,760	56,104	59,673	2/
Polypropylene glycol	87,469	79,488	95,987	94,059	100,558
Triethylene glycol	34,799	37,701	44,539	50,667	59,065

1/ Producers' sales. Production is not available.
2/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Glycols (other than propylene and ethylene glycols) and ether-glycols: U.S. exports, by principal markets, 1965-67

Market	1965	1966	1967
	Quantity (1,000 pounds)		
Netherlands	35,572	25,637	29,456
Belgium	26,503	22,541	33,513
Brazil	4,107	9,213	9,866
Argentina	2,169	4,276	8,137
Canada	3,519	5,153	4,727
Mexico	4,657	4,880	4,702
Australia	1,691	3,097	4,101
All other	18,625	21,410	23,474
Total	96,843	96,207	117,976
	Value (1,000 dollars)		
Netherlands	6,283	4,461	4,824
Belgium	2,737	2,400	3,670
Brazil	659	1,372	1,401
Argentina	495	659	1,178
Canada	755	1,088	1,113
Mexico	869	750	783
Australia	324	604	693
All other	3,463	4,167	4,426
Total	15,585	15,501	18,088

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Polyhydric alcohols and derivatives, not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Canada	1	16	315	1/ 10,687
West Germany	695	7,467	8,117	4,964
Japan	174	138	18	203
Switzerland	19	7	10	16
United Kingdom	49	60	12	13
Netherlands	-	-	220	-
Belgium-Luxembourg	-	2,607	-	-
France	89	35	-	-
All other	1	75	3	10
Total	1,028	10,405	8,695	15,893
	Value (1,000 dollars)			
Canada	1	4	86	1/ 4,449
West Germany	304	1,756	1,941	1,149
Japan	22	17	7	173
Switzerland	27	11	23	37
United Kingdom	33	53	6	13
Netherlands	-	-	52	-
Belgium-Luxembourg	-	600	-	-
France	75	13	-	-
All other	1	97	5	8
Total	463	2,551	2,120	5,829

1/ Entered duty free.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Amyl acetate	428.50

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Amyl acetates are a group of organic solvents and extractants of some importance to various industries but not important in international trade. In recent years, annual domestic sales have usually exceeded $1 million.

Description and uses

Commercial amyl acetate is a mixture of normal amyl, secondary amyl, and isoamyl acetate. Amyl acetates are made by the esterification of amyl alcohols, usually fusel oil, with acetic acid. Commercial amyl acetate is sold by grades indicating the purity (e.g., 85-90 percent). It is also sold according to the source from which made, such as fusel oil, from pentane, or from amyl alcohol produced from hydrocarbon gases (the oxo process). Commercial amyl acetate is used as a solvent for lacquers and paints; as an extractant in penicillin manufacture; in the manufacture of photographic film, leather polishes, drycleaning preparations, and nitrocellulose; as a flavoring agent; in printing and finishing textile fabrics; and as a solvent for phosphors in fluorescent lamps.

The individual isomeric forms of amyl acetate are produced by esterifying the corresponding amyl alcohol with acetic acid. Normal amyl acetate is a clear liquid with a pleasant, sweetish odor resembling that of bananas. Its uses are much the same as those for the commercial material. Secondary amyl acetate is also a colorless liquid sold in a technical grade. It is used as a solvent for cellulose compounds and in the manufacture of airplane dopes, leather finishes, textile sizing, and printing compounds. Isoamyl acetate is a colorless liquid derived from the rectification of commercial amyl acetate. It is used as a solvent and in flavorings and perfumes. Amyl alcohols and acetic acid, the raw materials for amyl acetates, are in plentiful supply in the United States.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.50	Amyl acetate------	2¢ per lb.	1¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent of the specific rate of duty in effect prior to January 1, 1968, based on a price of 16.5 cents per pound, was 12.1 percent.

U.S. producers

In 1966, amyl acetates were produced in the United States by six companies. Two are medium-sized firms engaged in the production of organic chemicals mainly for use in flavor and perfume chemicals. One is a fairly large firm which makes beverage alcohols and organic chemicals by fermentation. The remaining three are very large chemical companies which produce a great variety of chemicals. The producing plants are situated in the eastern part of the United States and on the gulf coast, and for none of the producers are amyl acetates a major source of income.

U.S. production

U.S. production of amyl acetates amounted to 10.3 million pounds in 1959 and decreased to 7.8 million pounds the following year. Since 1960, annual production has varied between 6.4 million pounds in 1963 and 9.5 million pounds in 1961. Production in 1964--the last year for which statistics are published by the Tariff Commission--amounted to 8.7 million pounds (see table). Significantly increased production in the future is not foreseen.

U.S. imports and exports

U.S. imports of amyl acetates are very unimportant. In 1959, imports amounted to 26,000 pounds, valued at $5,000, all from Italy. In 1962, 10 pounds was entered from Switzerland and in 1964 68,000 pounds, valued at $8,500, from West Germany. No imports were reported for 1965 and 1966. U.S. exports of amyl acetates are believed to be very small.

Amyl acetates: U.S. production and sales, 1961-64

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1961	9,515	6,850	1,712	$0.25
1962	8,225	5,738	1,000	.17
1963	6,361	6,012	998	.17
1964	8,664	7,106	1,193	.17

Source: U.S. Tariff Commission: Synthetic Organic Chemicals, United States Production and Sales.

Commodity	TSUS item
Butyl acetate----------	428.52

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendis A to this volume).

U.S. trade position

Butyl acetate has some importance in international trade and is an important item in the consuming industries. U.S. production in 1966 was about 130 million pounds; domestic sales in 1966 were 135 million pounds, valued at $12.9 million. Imports of butyl acetate have been very small. Exports are quite large, accounting for 36 percent of domestic production in 1964 and for 18 percent in 1966.

Description and uses

Butyl acetate is available in four isomeric forms which are produced by reacting the appropriate butyl alcohol with acetic acid. Normal butyl acetate is a clear liquid which is an important solvent in the production of lacquers, pyroxylin solutions, leather and airplane dopes, perfumes, and flavoring materials. It is also a good solvent for natural and synthetic gums and resins. Secondary butyl acetate is a good solvent for nitrocellulose, lacquers, nail enamel, and celluloid products. Tertiary butyl acetate is a solvent and has been suggested by the trade as an antiknock agent in motor fuels. Isobutyl acetate, a colorless liquid with a fruity odor, is used as a solvent for nitrocellulose and lacquers and in perfumes and flavoring materials. The basic materials for making butyl acetate (butyl alcohols and acetic acid), materials derived from petroleum, are in plentiful supply in the United States.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.52	Butyl acetate-----	3.5¢ per lb.	1.7¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of

trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent of the specific rate of duty in effect prior to January 1, 1968, based on imports in 1967, was 20.7 percent.

U.S. consumption

U.S. consumption of butyl acetate in recent years has ranged from 75 million to slightly more than 100 million pounds a year. This consumption has been slowly rising and will probably continue to do so. Normal butyl alcohol accounts for about 70 percent of consumption, and isobutyl and other isomers, for the remaining 30 percent.

U.S. producers

Butyl acetate is produced in the United States by seven very large chemical companies which are deeply involved in the manufacture of many petrochemicals. The plants producing butyl acetate are situated in New Jersey, Texas, Pennsylvania, Tennessee, and West Virginia. Butyl acetate is a minor product for the producing companies and is not a major source of income for any of them.

U.S. production

U.S. production of butyl acetate increased from 114.6 million pounds in 1961 to 131.5 million pounds in 1965 then declined slightly in 1966 (table 1). Except for 1962 and 1966, production of butyl acetates in each year exceeded that in the previous year.

Sales were 98.0 million pounds, valued at $12.7 million in 1961, and 135.2 million pounds, valued at $12.9 million, in 1966. The sales trend has been steadily upward and should continue during the next few years. The average unit value for all butyl acetates declined from 13 cents per pound in 1961 to 10 cents per pound in 1966.

U.S. imports

From 1958 to 1961 there were no imports of butyl acetate into the United States. In 1962, 162,260 pounds, valued at $9,014, was entered from Canada. Imports of butyl acetate in 1963 and 1964, all

from West Germany, amounted to 1,764 pounds, valued at $1,706, and 11,243 pounds, valued at $10,916, respectively. In 1965 Canada and Denmark shipped to the United States 53,100 pounds and 22,185 pounds, valued at $30,267 and $10,760, respectively. In 1966 the total for all countries amounted to only 1,598 pounds, valued at $320. Imports in 1967, all from Japan, amounted to 20,000 pounds, valued at $3,376.

U.S. exports

Exports of butyl acetate from the United States have been substantial in recent years, amounting to 35.8 million pounds in 1961 and 42.5 million pounds in 1964 (table 2). Exports declined in 1965 and 1966, amounting to 37.8 million pounds and 23.3 million pounds, respectively. Up to 1961 the principal foreign markets for U.S. butyl acetate were Belgium, the Netherlands, and Mexico, in that order; in 1961 and since the principal foreign buyers have been Belgium, Colombia, the Netherlands, Hong Kong, and Mexico.

World production and trade

The European Economic Community, Great Britain, and Japan, with their extensive petrochemical complexes, produce butyl acetate along with associated products. Butyl acetate is not likely to become an important factor in world trade in the immediate future.

Table 1.--Butyl acetate: U.S. production and sales, 1961-66

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1961	114,567	98,014	12,725	$0.13
1962	88,567	101,810	12,606	.12
1963	111,558	105,901	12,024	.11
1964	116,593	112,822	11,539	.10
1965	131,511	123,274	11,817	.10
1966	129,543	135,215	12,885	.10

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Butyl acetate: U.S. exports of domestic merchandise, 1961-67

Year	All countries	Belgium	Colombia	Netherlands	Mexico	Hong Kong	All other
	Quantity (1,000 pounds)						
1961	35,765	12,598	759	15,912	2,086	1,206	3,204
1962	28,327	10,948	251	12,496	1,684	354	2,594
1963	34,535	14,598	761	15,215	1,181	608	2,172
1964	42,545	25,614	1,074	10,243	1,125	1,167	3,322
1965	37,754	32,070	616	-	481	1,026	3,561
1966	23,267	16,048	1,771	-	103	1,866	3,479
1967	27,121	10,210	3,313	6,787	-	1,175	5,636
	Value (1,000 dollars)						
1961	4,403	1,577	121	1,771	287	161	486
1962	2,920	972	36	1,266	224	46	376
1963	3,390	1,306	100	1,455	155	77	297
1964	4,132	2,365	138	912	140	132	445
1965	3,468	2,777	78	-	56	118	439
1966	2,120	1,325	218	-	18	137	422
1967	2,468	847	428	419	-	96	678

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Ethyl acetate----------	428.58

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Ethyl acetate is one of the most important solvents used by the consuming industries. Production of ethyl acetate in 1966 was about 122 million pounds; sales were 115 million pounds, valued at $11 million. Ethyl acetate is not an important commodity in international trade.

Description and uses

Ethyl acetate is a colorless, flammable liquid with a pleasant odor. It is produced by the reaction of ethyl alcohol with acetic acid in the presence of sulfonic acid. The sale of ethyl acetate, like ethyl alcohol, is subject to Government regulation. Ethyl acetate is available in three grades: Commercial 85-88 percent, 95-98 percent, and 99 percent. Ethyl acetate, a fast-drying solvent, is used as a solvent for nitrocellulose, ethylcellulose, shellac, certain synthetic rubbers and vinyl resin, and cellulose acetate. It is also used as a solvent for inks, as a solvent and cleaning fluid in the textile industry, and in organic synthesis.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.58	Ethyl acetate-----	1.5¢ per lb.	0.75¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for each of the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968,

had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent of that specific rate of duty on ethyl acetate, based on imports in 1967, is 21.6 percent.

U.S. consumption and production

U.S. consumption of ethyl acetate is approximately equal to domestic production. Production was fairly steady during the period 1961-66, amounting to more than 100 million pounds a year (table 1). Production increased in each year except 1962 and 1965, when slight declines occurred. Production in 1966 recovered to 122 million pounds. This upward trend in production probably will not continue, because of the increased use of methyl ethyl ketone (item 427.62) which is lower in price, for solvent purposes. Trade sources estimate that more than 90 percent of the ethyl acetate used in the United States is for solvent purposes. The remainder goes into chemical manufacture or is exported.

U.S. producers

Ethyl acetate is produced in the United States by six companies in eight plants, one each in Massachusetts, Michigan, New Jersey, Pennsylvania, Tennessee, and West Virginia, and two in Texas. The producing companies are all very large chemical manufacturers which make a large variety of products; ethyl acetate is not a major source of income for any of them.

U.S. imports and exports

U.S. imports of ethyl acetate have been small in relation to domestic production (table 2). Prior to 1966, the bulk of the imports originated in Canada. In 1966 Japan replaced Canada as the largest foreign supplier of ethyl acetate to the United States. Exports of ethyl acetate are not separately classified in the official statistics; they are estimated by trade sources to amount to about 5 percent of domestic production.

Foreign production and trade

Ethyl acetate is produced in considerable volume by members of the European Economic Community, the United Kingdom, and Japan. Ethyl acetate is not an important commodity in international trade.

Table 1.--Ethyl acetate: U.S. production and sales, 1961-66

Year	Production 1/	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1961	102,325	86,075	9,835	$0.11
1962	101,879	90,149	10,230	.11
1963	117,507	107,692	11,830	.11
1964	117,746	101,212	10,366	.10
1965	114,013	100,197	10,425	.10
1966	121,596	114,909	11,218	.10

1/ 85-percent-pure basis.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Ethyl acetate: U.S. imports for consumption, by principal sources, 1961-67

Year	All countries	Canada	Other
	Quantity (1,000 pounds)		
1961	2,453	2,453	-
1962	1,458	1,435	23
1963	1,094	1,094	-
1964	1,427	1,427	-
1965	904	904	-
1966	3,860	1,596	1/ 2,264
1967	2,277	1,038	1/ 1,239
	Value (1,000 dollars)		
1961	324	324	-
1962	180	171	9
1963	116	116	-
1964	109	109	-
1965	76	76	-
1966	262	118	1/ 144
1967	158	78	1/ 80

1/ All from Japan.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Vinyl acetate	428.68

Note.--For the statutory description see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Vinyl acetate is a very important industrial chemical which is produced domestically in large volume. In 1966, domestic production amounted to 606 million pounds; sales were 254 million pounds, valued at $27 million. The difference between the quantities produced and those sold consisted largely of the amount consumed by the producing companies in the manufacture of polyvinyl acetate resins. Vinyl acetate generally is not an important item in international trade because most countries that use it also produce it.

Description and uses

Vinyl acetate is a colorless, flammable liquid with a sharp but not unpleasant odor. It is commercially available in the technical grade, which is stabilized against polymerization with hydroquinone or diphenylamine inhibitors. The material is produced principally by the vapor-phase process, in which gaseous acetic acid and acetylene are reacted in a heated vessel in the presence of charcoal and catalytic agents. One new plant in Texas uses a liquid-phase process, with ethylene and an acetic radical probably derived from sodium acetate. Another new plant uses acetaldeyde and acetic anhydride to form ethylidene diacetate, which then dissociates into acetic acid and vinyl acetate.

Virtually all of the vinyl acetate produced is polymerized to polyvinyl acetate resins (see summary for TSUS item 445.40), either by the original producers of the vinyl acetate or by about 60 polyvinyl acetate producers that purchase this raw material. There are no difficult technical problems in the transporting of vinyl acetate monomer.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.68	Vinyl acetate---	1.25¢ per lb. + 6.25% ad val.	0.6¢ per lb. + 3% ad val.

The rate effective January 1, 1972, is the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of the five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS) through 1967. The ad valorem equivalent of the compound rate of duty in effect prior to January 1, 1968, based on imports in 1967, was 15.4 percent.

U.S. producers

In 1968 there were seven U.S. companies producing vinyl acetate in nine plants, one each in Kentucky, Louisiana, New York, and West Virginia, and five in Texas. Six of the producers of vinyl acetate are very large, diversified chemical companies. The seventh producer specializes in the manufacture of adhesives, starches, resins, and chemicals. One of the leading producers completes its vinyl acetate requirements with material imported from Canada. For every producer, there are many products that individually are more important as sources of revenue than is vinyl acetate.

U.S. production and consumption

U.S. production of vinyl acetate (much of it captive) increased from 273 million pounds in 1961 to 405 million pounds in 1963, and 605 million pounds in 1967 (see accompanying table). Sales of vinyl acetate by domestic producers were 169 million pounds, valued at $25 million, in 1961 and 254 million pounds, valued at $27 million, in 1966. These figures show the large increase in both captive production, and production for sale, of vinyl acetate, and they reflect the substantial decline in price. Total U.S. consumption was probably at least as large as domestic production in every year of the period under review.

Imports and exports

U.S. imports of vinyl acetate declined from a peak of 42.4 million pounds in 1961 (equivalent to 17 percent of domestic production) to 23.3 million pounds in 1966 (equivalent to 4 percent of domestic production). Virtually all of the imports of vinyl acetate came from Canada. Small quantities were imported regularly from Japan and irregularly from West Germany, Switzerland, and the Netherlands.

U.S. exports of vinyl acetate are not separately classified in official statistics.

Foreign production and trade

Vinyl acetate is produced in substantial quantities in Japan, Canada, West Germany, France, Italy, and the United Kingdom. With the exception of exports by Canada to the United States and by European countries and Canada to the United Kingdom, vinyl acetate apparently does not enter into international trade in significant quantities.

VINYL ACETATE

Vinyl acetate: U.S. production, sales, and imports for consumption, by principal sources, 1961-67

Year	Production 1/	Sales	Imports for consumption from--			
			All countries	Canada	Japan	All other
	Quantity (1,000 pounds)					
1961	273,491	168,903	42,366	41,481	762	123
1962	317,912	189,330	24,645	24,221	292	132
1963	405,252	171,806	22,420	21,549	607	264
1964	440,331	217,310	17,523	16,914	459	150
1965	511,951	259,099	17,508	16,856	608	44
1966	605,544	254,239	23,288	22,833	395	2/
1967 3/	605,055	4/	25,965	25,400	565	-
	Value (1,000 dollars)					
1961	41,000	24,880	6,815	6,419	367	29
1962	44,500	26,350	3,665	3,477	159	29
1963	52,700	22,703	3,071	2,745	255	71
1964	48,400	24,731	2,381	2,198	152	31
1965	56,300	27,837	2,373	2,173	187	13
1966	66,600	27,204	3,136	3,021	115	5/
1967 3/	4/	4/	3,491	3,327	164	-

1/ Value of production calculated by using unit value of sales.
2/ Less than 500 pounds.
3/ Preliminary.
4/ Not available.
5/ Less than $500.

Source: Production and sales, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports compiled from official statistics of the U.S. Department of Commerce.

ESTERS OF MONOHYDRIC ALCOHOLS AND ORGANIC AND INORGANIC ACIDS (EXCEPT HYDROGEN SULFIDE AND HYDROGEN HALIDE ACIDS), NOT ELSEWHERE ENUMERATED

Commodity	TSUS item
Esters of monohydric alcohols and organic or inorganic acids (except hydrogen sulfide and hydrogen halide acids):	
Diethyl sulfate and dimethyl sulfate	428.54
Ethyl acrylate	428.62
Ethyl methacrylate	428.64
Methyl acrylate	428.66
Other esters not elsewhere enumerated	428.72

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. production of the miscellaneous esters of monohydric alcohols and organic and inorganic acids covered in this summary amount to about a billion pounds, valued at more than a third of a billion dollars. Imports and exports of these esters are not significant in international trade; U.S. imports in 1967 amounted to 10.1 million pounds worth $3.2 million, while exports of certain specified esters in the same year totaled 17.6 million pounds worth $4.2 million.

Description and uses

This summary covers all esters of monohydric alcohols and organic and inorganic acids except amyl, butyl, ethyl, and vinyl acetates, which are treated in separate summaries (TSUS items 428.50, 428.52, 428.58, and 428.68, respectively). 1/ This summary includes, in addition to simple esters, those having an epoxide, ether, acetal, or lactone function, or a halogen, sulfur, or metallic atom. Esters having an acid, aldehyde, or ketone function, or a nitrogen atom are classified under their respective groups.

Of approximately 170 esters covered in this summary, the following esters and ester groups are the most important commercially: Esters of acrylic and methacrylic acid; malathion and about a dozen more organophosphorus insecticides and herbicides; miscellaneous plasticizers, including esters of azelaic, citric, acetylcitric, and phosphoric acids; and other individual chemicals, such as diethyl

1/ Other important esters not covered in part 2 are in TSUS items 460.80, 490.90, 490.92, and 490.94.

maleate and malonate, diethyl and dimethyl sulfates, ethylidene diacetate, diethyl silicate, propyl and isopropyl acetates, isopropyl chloroformate, methyl acetoacetate, diethyl and dimethyl phosphorochlorethionate, and ethyl, methyl, and tributyl phosphates. These esters are produced by the reaction between the appropriate alcohol and a corresponding acid, usually in the presence of a catalyst. The acrylic esters covered in this summary are used in the manufacture of acrylic resins; the other esters are used principally as industrial solvents, in organic chemical synthesis, in insecticides and herbicides, and as plasticizers.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Esters of monohydric alcohols and organic or inorganic acids (except hydrogen sulfide and hydrogen halide acids): 1/		
428.54	Diethyl sulfate and dimethyl sulfate----	10.5% ad val.	5% ad val.
428.62	Ethyl acrylate--------	10.5% ad val.	5% ad val.
428.64	Ethyl methacrylate----	10.5% ad val.	5% ad val.
428.66	Methyl acrylate-------	10.5% ad val.	5% ad val.
428.72	Other esters not elsewhere enumerated----	10.5% ad val.	5% ad val.

1/ Language "and organic or inorganic acids (except hydrogen sulfide and hydrogen halide acids)" added by Public Law 89-241, effective Dec. 7, 1965.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

ESTERS OF MONOHYDRIC ALCOHOLS AND ORGANIC AND INORGANIC ACIDS (EXCEPT HYDROGEN SULFIDE AND HYDROGEN HALIDE ACIDS), NOT ELSEWHERE ENUMERATED

U.S. consumption and production

In 1966, total production amounted to slightly more than 1 billion pounds, valued at $340 million. Approximately 50 of the esters covered here have a value of production of at least $1 million each, and together accounted for 93 percent of the total quantity of production and 77 percent of the total value. The acrylic and methacrylic acid esters accounted for approximately 60 percent of the total quantity of the esters produced and 41 percent of the total value. U.S. consumption equals production plus a very small amount of imports less a slightly larger amount of exports.

Producers

The esters included in this summary are produced by 57 companies. In 1966 four very large producers accounted for 73 percent of the total quantity and 67 percent of the total value of the esters produced. The bulk of the production is concentrated in the East and South. For the most part, these companies make a large variety of other products, and these esters are not a significant source of income for any of them.

U.S. imports and exports

U.S. imports of the esters covered in this summary increased from 1,993,000 pounds, valued at $890,000, in 1964 to a high in 1966 of 17,891,000 pounds, valued at $4,760,000; imports in 1967 amounted to 10,151,000 pounds, valued at $3,167,000 (see table). The principal supplying countries were West Germany, Japan, the Netherlands, the United Kingdom, Switzerland, and Canada. An analysis of available import documents for 1966 showed that the principal materials imported were as follows: Methyl methacrylate, from West Germany and Japan; ethyl acrylate, principally from Japan but also from West Germany and France; methyl acrylate, principally from West Germany; butyl lactate, from the United Kingdom; and ethyl lactate, principally from the Netherlands and Japan.

Official export statistics for the esters covered in this summary are available only for 1966-67. In 1967 the United States exported 10.0 million pounds of ethyl acrylate monomer, valued at $2.3 million, principally to Australia, Mexico, the Netherlands, Canada, and Argentina. In 1967, exports of butyl, 2-ethyl hexyl, and methyl acrylate monomers amounted to 7.6 million pounds, valued at $1.9 million, and went principally to Canada and Australia.

ESTERS OF MONOHYDRIC ALCOHOLS AND ORGANIC AND INORGANIC ACIDS (EXCEPT HYDROGEN SULFIDE AND HYDROGEN HALIDE ACIDS), NOT ELSEWHERE ENUMERATED

In 1966, exports of ethyl acrylate monomer totaled 6.8 million pounds, valued at $1.6 million, with Canada being the largest customer. In 1966, exports of butyl, 2-ethyl hexyl, and methyl acrylate monomer amounted to 13.1 million pounds, valued at $3.1 million; the chief importers of this material were the United Kingdom, Belgium, Australia, Mexico, Canada, and France.

Foreign production and trade

Although precise statistics are not available, almost all of the countries in Western Europe, as well as Japan, produce esters of monohydric alcohols and organic and inorganic acids in considerable quantities.

ESTERS OF MONOHYDRIC ALCOHOLS AND ORGANIC AND INORGANIC ACIDS (EXCEPT HYDROGEN SULFIDE AND HYDROGEN HALIDE ACIDS), NOT ELSEWHERE ENUMERATED

Esters of monohydric alcohols and organic and inorganic acids, not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
West Germany	218	688	9,399	5,610
Japan	-	125	5,327	1,219
Netherlands	124	324	1,019	708
United Kingdom	407	424	986	523
Switzerland	403	183	368	574
France	1	34	449	308
Canada	838	458	269	778
All other	2	-	74	431
Total	1/ 1,993	2/ 2,236	3/ 17,891	4/ 10,151
	Value (1,000 dollars)			
West Germany	186	461	1,910	1,206
Japan	-	50	1,042	233
Netherlands	40	128	513	565
United Kingdom	177	189	606	206
Switzerland	384	225	466	637
France	1	10	115	88
Canada	93	58	29	100
All other	9	-	79	132
Total	1/ 890	2/ 1,121	3/ 4,760	4/ 3,167

1/ Includes 168 thousand pounds of diethyl sulfate and dimethyl sulfate, valued at 15 thousand dollars, from the United Kingdom.

2/ Includes 161 thousand pounds of diethyl sulfate and dimethyl sulfate, valued at 14 thousand dollars from the United Kingdom.

3/ Includes 257 thousand pounds of diethyl sulfate and dimethyl sulfate, valued at 21 thousand dollars, from the United Kingdom; 4.5 million pounds of ethyl acrylate, valued at 870 thousand dollars, mostly from Japan but also from West Germany, France, Canada, and Spain, in that order; and 1.3 million pounds of methyl acrylate, valued at 194 thousand dollars, mostly from West Germany.

4/ Includes 210 thousand pounds of diethyl sulfate and dimethyl sulfate, valued at 18 thousand dollars, from the United Kingdom.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Ethylene oxide	428.84

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of ethylene oxide, one of the leading petrochemical intermediates, has been increasing rapidly. Generally, the producers use about 90 percent of domestic output (total output amounted to 2.3 billion pounds in 1967). U.S. imports are negligible. Virtually all of the producing countries consume practically all of their own production.

Description and uses

Ethylene oxide is a toxic, explosive gas under normal atmospheric conditions. Consequently, for shipment, it is liquefied and transported in specially designed tank cars and trucks.

Ethylene oxide is produced principally by the catalytic oxidation of ethylene (item 429.50) with either air or oxygen. A relatively small amount is produced by the older method of alkaline hydrolysis of ethylene chlorohydrin (item 428.22).

The major derivative of ethylene oxide is ethylene glycol (item 428.34), which is used as an automotive antifreeze. Other important derivatives are polyester fibers, ethanolamines (item 425.12), polyglycol ethers and esters (item 428.46), and certain surface-active agents (part 8 of schedule 4). The large number of end products made from derivatives of ethylene oxide includes various plastics materials, textiles, pharmaceuticals, toilet preparations, agricultural chemicals, explosives, detergents, hydraulic fluids, and heat-transfer agents for automotive and aviation vehicles.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.84	Ethylene oxide--------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on ethylene oxide was 37.6 percent; it was 33.4 percent for the rate in effect on January 1, 1968.

U.S. producers

In 1966 ethylene oxide was produced by 11 firms at 18 locations, seven in Texas, three in Louisiana, two in West Virginia, and one each in California, Indiana, Kentucky, New Jersey, Pennsylvania, and Puerto Rico. The producers consist of large petrochemical firms and subsidiaries operated as joint ventures of petroleum and chemical corporations. Most of them also produce ethylene glycol and di-, tri-, and polyethylene glycols, and half also produce substantial volumes of ethanolamines and other glycol ethers and esters.

U.S. production, exports, and imports

Exclusive of exports which are not reported separately, U.S. consumption of ethylene oxide approximates production, since imports are negligible. U.S. production of ethylene oxide increased rapidly from 1.2 billion pounds in 1958 to 1.5 billion pounds in 1962 and to 2.3 billion pounds in 1966 (table 1). About 90 percent of the ethylene oxide produced is used by its producers in the manufacture of ethylene glycol, certain surface-active agents, ethanolamines, and other glycol ethers and esters.

Sales of ethylene oxide go principally to the producers of surface-active agents and other organic chemicals. Sales increased rapidly from 100 million pounds, valued at $14.3 million (14 cents per pound), in 1958 to 157 million pounds, valued at $18.6 million (12 cents per pound), in 1962 and 304 million pounds, valued at $29.6 million (10 cents per pound), in 1966 (table 1). Price reductions resulted from economies of the direct oxidation process, referred to in description and uses.

Statistics on imports of ethylene oxide are not available for years prior to 1964. Imports amounted to 3.5 million pounds, valued at $518,000, in 1964 and decreased to 1.3 million pounds, valued at $175,000, in 1967 (table 2). They came principally from Canada, where the two largest U.S. producers have plants. Much of the duty collected on imports of ethylene oxide is refunded under drawback on exports of derivatives in which the material is used.

Foreign production and trade

Ethylene oxide is produced at more than a score of plants in Eastern Europe, five in Japan, and less than a dozen plants in other parts of the world. The major U.S. producers manufacture abroad through their affiliates, but they do not account for a large share of foreign production.

Table 1.--Ethylene oxide: U.S. production and sales, 1961-67

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1961	1,355,957	128,072	17,025	$0.13
1962	1,517,968	156,880	18,639	.12
1963	1,888,760	170,386	18,698	.11
1964	2,163,035	198,209	20,502	.10
1965	2,189,798	255,952	25,994	.10
1966	2,326,901	304,162	29,598	.10
1967	2,307,831	301,705	26,931	.09

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Ethylene oxide: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Canada	3,493	305	145	1,244
West Germany	21	127	113	74
All other	1/	-	1	1
Total	3,514	432	259	1,319
	Value (1,000 dollars)			
Canada	509	44	21	157
West Germany	7	26	21	17
All other	2	-	1	1
Total	518	70	43	175

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Propylene oxide----------	428.86

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. consumption of propylene oxide, a petrochemical intermediate, is growing rapidly. Roughly 90 percent of the domestic output (the total amounted to 814 million pounds in 1967) is used by the producers themselves. U.S. imports are negligible. Generally, the producing countries consume the great bulk or virtually all of their own production.

Description and uses

Propylene oxide is a volatile, flammable, moderately toxic liquid. The two most important derivatives of propylene oxide are propylene glycol (item 428.30) (which is used in the synthesis of plastics and plasticizers, and as a humectant, hydraulic fluid, and antifoam agent) and polypropoxy ethers (items 428.40 and 428.46) (which are intermediates in the synthesis of polyurethane foams for insulation and upholstery padding). Other derivatives include polypropylene glycols (item 428.46) and surface-active agents (part 8 of schedule 4).

Propylene oxide is obtained principally by alkaline hydrolysis of propylene chlorohydrin (item 428.24). Most of the facilities now used for the production of propylene oxide were formerly used for the production of ethylene oxide by the chlorohydrin process. The conversion followed the construction of facilities for the production of ethylene oxide by direct oxidation, a more economical process than the older one.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
428.86	Propylene oxide------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963, the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on propylene oxide was 46.2 percent; it was 41.0 percent for the rate in effect on January 1, 1968.

U.S. producers

In 1967 propylene oxide was produced by six large chemical companies, at eight locations; three in Texas, two in Michigan, and one each in Kentucky, Louisiana, and West Virginia. The five largest producers are also large producers of ethylene oxide, ethylene glycol, propylene glycol, and ethoxy and propoxy ethers and esters.

U.S. consumption, production, and exports

Owing to a rapidly growing demand for polyurethane foams derived from propylene oxide, U.S. consumption and production of propylene oxide have enjoyed rapid growth. U.S. consumption of propylene oxide approximates production, since imports are relatively small. U.S. production of propylene oxide increased rapidly from 288 million pounds in 1959 to 446 million pounds in 1962 and 797 million pounds in 1967 (see accompanying table). Almost 90 percent of the propylene oxide produced is used by its producers in the manufacture of derivatives such as propylene glycol and propoxy ethers and esters.

Sales by U.S. producers go principally to producers of propoxy ethers, surface-active agents, and other organic chemicals. Sales increased rapidly from 35.7 million pounds, valued at $4.8 million, in 1961, to 83.3 million pounds, valued at $8.6 million, in 1966.

U.S. imports

Statistics on imports of propylene oxide are not available for years prior to 1964. Imports since that date are given below: 1/

Year	Quantity (1,000 pounds)	Value (1,000 dollars)	Source
1964-----	955	112	Canada
1965-----	617	52	Canada
1966-----	22	4	West Germany
1967-----	653	63	Canada

Imports from Canada probably originated in an American owned plant.

Foreign production and trade

Propylene oxide is produced in Europe, Japan, and Canada by the principal producers of ethylene oxide but at fewer locations and in substantially smaller volume.

1/ Compiled from official statistics of the U.S. Department of Commerce.

Propylene oxide: U.S. production and sales, 1961-68

Year	Production	Sales	
		Quantity	Value
	1,000 pounds	1,000 pounds	1,000 dollars
1961	374,153	35,655	4,768
1962	446,199	60,091	7,336
1963	496,921	51,625	6,072
1964	569,060	60,319	7,583
1965	604,559	69,254	8,298
1966	710,471	83,257	8,648
1967	813,967	75,847	7,247
1968	1/ 957,824	2/	2/

1/ Preliminary.
2/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Commodity	TSUS item
Butylene oxide	428.80
Epichlorohydrin	428.82
Epoxides not elsewhere enumerated	428.88

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The epoxides in the group covered in this summary are intermediates for other chemicals and are of limited importance in international trade. U.S. imports and exports are generally small compared with production, which was probably less than 250 million pounds in 1966.

Description and uses

Epoxides 1/ are very reactive organic compounds containing an atom of oxygen joined to two carbon atoms in a continuous chain, generally forming a 3- or 4-membered ring. They are derived principally from petroleum and natural gas.

Two more important epoxides--ethylene oxide (item 428.84) and propylene oxide (item 428.86) are discussed in separate summaries. Butylene oxide is used as a scavenger for chlorine-containing compounds and as an intermediate in the synthesis of polybutoxy ethers but is of limited commercial importance. Epichlorohydrin--the third most important epoxide--and other epoxides, such as allyl glycidyl ether and cycloaliphatic epoxides, are intermediates used in the synthesis of epoxy resins. Epichlorohydrin is also used as an intermediate for synthetic glycerine.

Epoxides are produced principally either by the alkaline hydrolysis of a halohydrin (see separate summary on halohydrins) or by the peroxide oxidation of a compound containing a double bond.

1/ According to the TSUS order of precedence of functions, the classification for epoxides includes not only simple epoxides but also those which contain an ether, acetal, or lactone function, or a halogen, sulfur, or metallic atom. The classification does not include epoxides which contain an acidic, aldehyde, ketone, alcohol, or ester function or a nitrogen atom (see headnote 1, schedule 4, part 2D).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Epoxides and halogenated epoxides:		
428.80	Butylene oxide-----	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7% ad val.
428.82	Epichlorohydrin----	10.5% ad val.	5% ad val.
428.88	Epoxides not elsewhere enumerated.	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7% ad val.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on other epoxides was 27.4 percent; it was 24.3 percent for the rate in effect on January 1, 1968. Imports of butylene oxide or epichlorohydrin in recent years have not been representative.

U.S. production, exports, and imports

In 1966 epichlorohydrin was produced by three companies and butylene oxide by two. Smaller amounts of other epoxides were produced by several other companies.

Production of the epoxides in this group is considerably smaller than production of ethylene or propylene oxides. The exact figures are not available for publication but probably did not exceed 250 million pounds in 1966, though production has been increasing steadily. Exports are probably small or nonexistent.

Sales of epichlorohydrin by U.S. producers--although substantially smaller than production--increased rapidly from 12.7 million pounds, valued at $4.0 million (31¢ per pound), in 1958 to 19.3 million pounds

valued at $4.8 million (25¢ per pound), in 1962, and 32.0 million pounds, valued at $7.2 million (22¢ per pound), in 1964, the latest year for which they have been published (table 1).

Statistics on imports of epoxides are not available for the years prior to 1964. There have been no imports of butylene oxide or epichlorohydrin since then. Imports of other epoxides increased rapidly from 27,000 pounds, valued at $14,000, in 1964, to 5.5 million pounds, valued at $1.3 million, in 1966, then decreased to 2.8 million pounds, valued at $665,000, in 1967 (table 2). West Germany has been the principal source.

Table 1.--Epichlorohydrin: Sales by U.S. producers, 1961, 1962, and 1964

Year	Quantity	Value	Unit value
	1,000 pounds	1,000 dollars	Per pound
1961	20,121	4,966	$0.25
1962	19,287	4,784	.25
1964	32,045	7,165	.22

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Note.--No statistics are available for total U.S. production or sales in 1963, 1965, 1966, or 1967.

Table 2.--Epoxides not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
West Germany	27	1,048	5,407	2,774
Canada	-	-	80	-
France	-	2	26	-
Belgium	-	1,190	-	-
All other	-	-	-	2
Total	27	2,240	5,513	2,776
	Value (1,000 dollars)			
West Germany	14	261	1,313	662
Canada	-	-	10	-
France	-	2	5	-
Belgium	-	291	-	-
All other	-	-	-	3
Total	14	554	1,328	665

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Ethers of monohydric alcohols:	
Ethyl	428.90
Isopropyl	428.92
Vinyl	428.94
Other	428.96
Acetals	429.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The nonbenzenoid ethers of monohydric alcohols are not important in international trade because the four most important domestically produced ethers--bis(2-chloroethyl)ether, ethyl ether, isopropyl ether, and methyl ether--are primarily obtained as byproducts. The fact that these four ethers are all highly volatile chemicals and all, except bis(2-chloroethyl)ether, very flammable is another deterrent to international trade. Estimated U.S. production of all the nonbenzenoid ethers was 160 million pounds in 1966.

The nonbenzenoid acetals are not important either in international trade or in the domestic industry. Imports amounted to only 7,000 pounds in 1967.

Description and uses

Ethers can be described as alcohols in which the hydrogen atom of the hydroxyl group has been replaced by a hydrocarbon (alkyl) radical. They are generally stable, neutral compounds. Methyl ether, the lowest member of the series, is a gas at room temperature and pressure, and the other ethers covered here are liquids. The individual ethers covered by this summary are ethyl ether (item 428.90), isopropyl ether (item 428.92), and vinyl ethers (item 428.94). Also covered here are other ethers of monohydric alcohols (item 428.96). 1/

1/ According to the TSUS order of precedence of functions, the classifications for ethers of monohydric alcohols include not only single ethers but also those which contain a lactone function or a halogen, sulfur, or metallic atom. The classification does not include ethers which contain an acid, aldehyde, ketone, alcohol, ether, or epoxide function or a nitrogen atom. Ethers of polyhydric alcohols are covered in separate summaries (items 428.30 through 428.46). Ethers of monohydric alcohols with a benzenoid or quinoid structure are covered in schedule 4, part 1 of the TSUS.

Four of the 17 ethers of monohydric alcohols now in commercial use are of primary interest since they now account for nearly all of the annual production. They are bis(2-chloroethyl)ether, ethyl ether, isopropyl ether, and methyl ether. The most important of these four is ethyl ether, which represents more than 60 percent of the total U.S. production. Bis(2-chloroethyl)ether is prepared by heating ethylene chlorohydrin with sulfuric acid; by saturating an aqueous solution of ethylene chlorohydrin with chlorine and ethylene; or as a byproduct in the production of glycol from ethylene oxide. The three remaining major ethers are prepared commercially as byproducts of the manufacture of their corresponding alcohols from the alkylene olefins (e.g., ethylene). These four ethers are used as solvents, as extracting mediums, as reaction mediums, as entrainers for dehydration purposes, as scouring agents for textiles, as intermediates in the manufacture of other chemicals and plastics, in spot-removing formulations, and in refrigeration. A special U.S.P. grade of ethyl ether is used as a general anesthetic in surgery.

The four previously mentioned ethers are highly volatile and all, except bis(2-chloroethyl)ether, are very flammable. Therefore, transportation costs are relatively high in comparison with production costs, a condition which makes long-distance shipping of these materials economically impracticable. For example, ethyl ether has a factory price of 6 cents a pound, while trade journals list this product at a delivered price in the east of 11 cents a pound in tank car quantities.

Also covered in this summary are acetals (item 429.00). They are clear, mobile liquids which are usually prepared by the reaction of an aldehyde or a ketone with an alcohol and have the general formulas $RCH(OR')$ and $R_2C(OR')_2$, respectively. They may be regarded as the diethers of the hydrates of carbonyl compounds.

Bis(2-chloroethoxy)methane is the only one of the six acetals now produced that is of commercial significance. It is used almost exclusively as an intermediate in the manufacture of polysulfide rubber. The other acetals are used as antioxidants in perfumes and soaps, as process solvents, and as plasticizers. Production statistics may not be published for the acetals because publication would disclose the operations of individual producers.

The acetal resins are covered in a separate summary (item 445.50).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Ethers of monohydric alcohols:		
428.90	Ethyl----------	2¢ per lb.	1¢ per lb.
428.92	Isopropyl----------	10.5% ad val.	5% ad val.
428.94	Vinyl----------	2.5¢ per lb. + 12.5% ad val.	1.2¢ per lb. + 6% ad val.
428.96	Other----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.
429.00	Acetals----------	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalents of the rates of duty in effect on December 31, 1967, for ethyl ether, vinyl ether, other ethers, and acetals were 2.9 percent, 17.7 percent, 32.5 percent, and 17.9 percent, respectively; they were 2.6 percent, 15.6 percent, 28.5 percent, and 15.7 percent, respectively, for the rates in effect on January 1, 1968.

U.S. consumption

U.S. consumption of the ethers of monohydric alcohols increased from about 133 million pounds in 1961 to about 159 million pounds in 1966. Ethyl ether, the most important commodity covered here, has accounted for 60 percent or more of total annual ether consumption in recent years.

Ethyl ether, which is obtained as a byproduct in the production of ethyl alcohol, can be adjusted to demand by converting excess ethyl ether output to ethyl alcohol (ethanol). Since ethyl ether competes

with both its starting material, ethylene, and its parent product, ethanol, as an intermediate in the manufacture of chemicals, the price level of ethyl ether is influenced by the price levels of the other two. The production of ethyl ether also depends on the market demand for ethanol; if the demand for ethanol declines, less ethyl ether is produced.

The largest single market for ethyl ether is as a chemical intermediate; about 50 to 60 percent of its annual production is now used for this purpose.

U.S. producers

In 1966, there were 15 U.S. companies producing the nonbenzenoid ethers of monohydric alcohols at 20 plants situated in Texas (four plants), Louisiana (three), West Virginia (three), Michigan (two), New Jersey (two), and California, Illinois, Missouri, New York, Pennsylvania, and Virginia (one each). During 1966, ethyl ether was produced by six of these firms at seven plants in seven States. The producers of ethers of monohydric alcohols range from medium size to the very largest members of the chemical industry. They are all highly diversified companies and make a variety of chemicals.

Captive use of ethers to make other products is insignificant. For example, in 1966 about 63 percent of total ether production and more than 87 percent of the ethyl ether output were sold in the open market.

In 1966 the acetals were produced by four companies--in Indiana, Michigan, New Jersey, and Texas. The producing firms range from medium in size to among the largest in the chemical industry. The acetals account for only a negligible portion of the producers' annual income.

The most important of the nonbenzenoid acetals, bis(2-chloroethoxy)methane, is used entirely by the producer in the manufacture of other products.

U.S. production

U.S. production of all nonbenzenoid ethers of monohydric alcohols increased from 134 million pounds in 1961 to 160 million pounds in 1966 (see accompanying table). During this period, production of ethyl ether accounted for 65 to 71 percent of the total annual ether output. The production of ethyl ether followed the same trend as the total ether production, increasing from 91 million pounds in 1961 to 107 million pounds in 1966.

The average unit value for the total ether production was 7 cents a pound in 1961, increased to 7.6 cents a pound in 1965, and then increased again in 1966 to 8.6 cents a pound; however, ethyl ether, all grades, has had an average unit value of 6 cents a pound in 1965 and since, less than the average unit value of 7 cents a pound in 1961, 1963, and 1964. Ethyl ether was 9 cents a pound in 1962.

Statistics on acetal production may not be published; however, output of these chemicals has increased over the past several years, owing primarily to the growth of bis(2-chloroethoxy)methane which is used captively.

U.S. exports

Official export statistics were available for ethyl ether only through 1964. From 1961 through 1964, exports of ethyl ether ranged from about 650,000 pounds to nearly 900,000 pounds (see accompanying table). This represents 1 percent or less of the annual production of ethyl ether. The major export market for ethyl ether has been Canada, which accounted for 50 to 70 percent of the total exports from 1961 through 1964. Venezuela, Colombia, Turkey, and Panama also have received exports of ethyl ether. For 1964 the average export value of ethyl ether was 44 cents a pound.

Exports of acetals, are probably insignificant since the most important one, bis(2-chloroethoxy)methane, is used entirely by the manufacturer in its own operations.

U.S. imports

Official import statistics were available only for ethyl ether until after the TSUS became effective on August 31, 1963. There were no imports of ethyl ether in 1961-64 or 1966. Imports of ethyl ether in 1965 amounted to 11,023 pounds, valued at $12,000, and all came from Spain; imports in 1967 amounted to 9,000 pounds, valued at $6,243, and all came from Sweden. There have been no imports of isopropyl ether reported since the TSUS became effective.

Imports of vinyl ether during the last third of 1963 totaled 112,000 pounds, valued at $23,000. In 1964 all vinyl ether imports came from West Germany and totaled 779,000 pounds, valued at $255,000. In 1965, 1966, and 1967 such imports amounted to 321,430 pounds, valued at $103,671; 178,343 pounds, valued at $87,813; and 135,142 pounds, valued at $65,059, respectively. West Germany and Japan accounted for all the vinyl ether imports in 1965, 1966, and 1967, with West Germany accounting for 80 to 98 percent of the annual total during these years.

Imports of other ethers of monohydric alcohols amounted to 2,000 pounds, valued at $700, during the last third of 1963, and to 75,000 pounds, valued at $40,000, in 1964. In 1965, 1966, and 1967, imports of these ethers amounted to 413,245 pounds, valued at $217,298; 1,452,392 pounds, valued at $196,469; and 167,023 pounds, valued at $28,708, respectively. West Germany was the principal source of these imports, accounting for 40 to 90 percent of the annual total. Belgium, Canada, Sweden, Switzerland, and the United Kingdom have also been important sources of imports.

Official statistics for the acetals were not available until after the TSUS became effective on August 31, 1963. There were no imports reported during the last 4 months of 1963; imports since then have been as follows:

Year	Quantity (1,000 pounds)	Value (1,000 dollars)	Unit value (per pound)
1964	1,281	1,986	$1.55
1965	700	1,862	2.66
1966	167,873	75,071	.45
1967	6,917	7,143	1.03

West Germany has been the principal source of acetal imports, except in 1966, when the Netherlands accounted for 58 percent of the total, and West Germany, for 42 percent. Other important sources have been France and Switzerland.

Foreign production and trade

The ethers of monohydric alcohols are produced in Canada, and European Economic Community countries, the European Free Trade Association nations, and Japan. Any country which produces ethyl alcohol, glycol, isopropyl alcohol, or methyl alcohol can easily obtain, as by-products, the four most important ethers covered in this summary.

Since it is costly to ship large quantities of these four ethers great distances from the producing plants because of their volatile and/or flammable nature, and since their cost of production is low, it is highly unlikely that any of the important ethers covered in this summary will ever become major items of international trade.

The acetals are produced in France, the Netherlands, Switzerland, West Germany, and possibly some other countries.

Ethers of monohydric alcohols: U.S. production, imports for consumption, and exports of domestic merchandise, 1961-67

Year	Production 1/	Imports 2/	Exports 3/
	Quantity (1,000 pounds)		
1961	134,341	-	899
1962	130,882	-	654
1963	116,816	112	775
1964	129,122	779	873
1965	142,544	746	4/
1966	5/ 160,000	1,631	4/
1967	6/	311	4/
	Value (1,000 dollars)		
1961	9,857	-	390
1962	9,374	-	303
1963	8,177	23	337
1964	9,684	255	387
1965	10,833	333	4/
1966	5/ 13,700	284	4/
1967	6/	100	4/

1/ Value of production calculated using the unit value of sales of all products included.

2/ Separate import statistics for acyclic ethers of monohydric alcohols --except ethyl ether--did not become available until after Aug. 31, 1963. There were no imports of ethyl ether in 1961 or 1962.

3/ Data are for ethyl ether only. Separate export statistics are not available for the other ethers included herein; however, the volume of such exports, if any, is very small.

4/ Separate statistics are no longer available.

5/ Owing to a new statistical grouping in the miscellaneous section of the report Synthetic Organic Chemicals, United States Production and Sales 1966, this figure is an estimate. Publication of an estimate was necessary in order to avoid disclosure of individual company operations.

6/ Not available.

Source: Production compiled by the U.S. Tariff Commission from information reported in confidence by the producers. Imports and exports compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Lactones:	
Butyrolactone	429.10
Other	429.12

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. consumption of lactones is valued at less than $20 million and is supplied principally by production. Exports are probably negligible.

Description and uses

Lactones are internal cyclic esters which are theoretically formed by the elimination of water from a hydroxy carboxy acid. Less than a dozen lactones are commercially important. They are generally derived from petroleum or natural gas and are used principally by their producers as intermediates in the synthesis of other chemicals. Butyrolactone is derived from the high-pressure ethynylation of acetylene and is used principally as an intermediate in the synthesis of polyvinylpyrrolidone polymer which, in turn, is used as a film former in hair sprays, as a blood-plasma extender, and as a clarifying agent for beer and wine. Smaller amounts are sold for use as a solvent and intermediate. Caprolactone is derived from hexanediol and used as an intermediate for urethane elastomers. Propiolactone is derived from acetone and used as an intermediate for acrylate ester resins. Other lactones are used as medicinal intermediates.

According to the TSUS order of precedence of functions, the classification for lactones includes not only simple lactones but also those which contain one hydroxyl function, or a halogen, sulfur, or metallic atom. The classification does not include lactones which contain two hydroxyl functions or one or more acid, aldehyde, ketone, ester, epoxide, or ether function, or a nitrogen atom (see schedule 4, part 2D, headnote 1). Lactones, such as nonalactone and undecalactone, which are used chiefly in the manufacture of perfumery, are classified under item 460.80.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Lactones:		
429.10	Butyrolactone------	12.5% ad val.	6% ad val.
429.12	Other----------	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, exports, and imports

Annual U.S. production is estimated to be valued at less than $20 million. Less than a third of the total production is sold. Exports are negligible.

Butyrolactone is one of a number of high-pressure acetylene chemicals made in the United States by one firm--a company that before World War II was owned by the original German producer. Caprolactone is produced by a large petrochemical company. Propiolactone is produced by a large producer of callulosic plastics and polymers for fibers.

Statistics on imports of lactones are not available for the years prior to 1964. Imports, as shown in the accompanying table, totaled 410,000 pounds, valued at $332,000, in 1964, and increased to 2.4 million pounds, valued at $910,000, in 1966, when they accounted for at least 5 percent of consumption; they declined sharply to 641,000 pounds, valued at $221,000, in 1967. Imports have consisted principally of butyrolactone from West Germany and medicinal intermediates from West Germany and Switzerland.

Foreign production and trade

Butyrolactone is produced in West Germany, and other lactones are produced in Canada, Europe, and Japan, but no statistics on the production are available.

Lactones: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
West Germany	367	199	2,418	629
Switzerland	43	7	20	10
Canada	1/	-	1/	-
United Kingdom	-	20	1/	2
All other	-	3	-	1/
Total	410	229	2,438	641
	Value (1,000 dollars)			
West Germany	222	388	872	176
Switzerland	105	22	37	41
Canada	3	-	2/	-
United Kingdom	-	6	1	1
All other	2	5	-	3
Total	332	421	910	221

1/ Less than 500 pounds.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Halogenated hydrocarbons are nonbenzenoid organic chemicals in which one or more of the hydrogen atoms in the hydrocarbon molecule has been replaced by a halogen (chlorine, fluorine, bromine, or iodine). There are more than a hundred of these compounds which are covered in detail in the following 11 separate summaries. The group includes many petrochemical intermediate and finished compounds for which combined annual production is valued at $1 billion. Imports and exports of these materials amount to less than five percent of the value of production. Benzenoid halogenated hydrocarbons are covered in part 1, schedule 4 of the TSUS.

Most halogenated hydrocarbons are water-insoluble, colorless, heavy, nonflammable, volatile liquids. Some are gases (usually compressed), and a few are solids. In the presence of air, heat, and moisture, they may decompose slowly to form corrosive acids. In commercial practice, a stabilizer or inhibitor (usually a phenolic or an amino compound) is frequently added to the halogenated hydrocarbon for its preservation during storage and transportation.

Chlorine has the widest natural distribution, lowest cost, and greatest use of all halogens. The chlorine derivatives of one- and two-carbon hydrocarbons (methane, acetylene, and ethylene) comprised more than 90 percent of the total volume of production and more than 70 percent of the total value of sales of halogenated hydrocarbons by U.S. producers in 1966. The remainder consisted principally of brominated and chlorofluorinated one- and two-carbon hydrocarbons. These were usually priced several times as high as the corresponding chlorine derivatives. The chlorine derivatives have been of commercial importance for many years; the fluorine derivatives have become important more recently.

Uses

The molecular structure of the halogenated hydrocarbons affects their physical and chemical properties and the uses for which they are suitable. As the hydrogen in the hydrocarbon is replaced by a halogen in the progressive order of fluorine, chlorine, bromine, and iodine, the compounds change from gases to liquids to solids, their flammability decreases, and their reactivity increases. An increase in molecular weight likewise causes a change from gas to liquid to solid. Unsaturated compounds 1/ are easily polymerized to plastics materials.

1/ Compounds in which a carbon atom's valence of four is satisfied in part by a double or triple bond with another carbon atom and in part by bonds with one or two other atoms (-$\dot{C}$=$\dot{C}$- and -C≡C-) in contrast with saturated compounds, where the valence is satisfied by bonds with four other atoms (-$\dot{C}$-).

In many uses the halogenated hydrocarbons are competitive with the plain hydrocarbons to which they are related. Although the halogenated hydrocarbons are more expensive, they are less flammable and more versatile.

The compounds which are gases under normal conditions are generally used in a compressed--or liquid--state. They vaporize rapidly when the pressure is released, absorbing heat from their surroundings. In closed units where they are continuously compressed and expanded, these compounds form the basis for air-conditioning and refrigerating systems. Halogenated hydrocarbons used as refrigerants include ethyl chloride, methyl chloride, methylene chloride, and several fluorocarbons. Other chemicals which are used as refrigerants include ammonia, hydrocarbons, carbon dioxide, and sulfur dioxide. Selection of the refrigerant for a particular application depends on the overall cost, the conditions under which the system will be operated, and the type of compressor system to be used.

Compressed gases are sometimes enclosed in containers with other chemicals or chemical products. When the pressure is released, these gases--known as aerosol propellants--vaporize rapidly, pushing the other materials from the container. Aerosol sprays are used in a variety of household and industrial applications, including cosmetics, toilet preparations, pharmaceuticals, insecticides, paints, and cleaning preparations. Halogenated hydrocarbons used as propellants include methylene chloride, vinyl chloride, and several fluorocarbons. Other chemicals used as propellants are carbon dioxide, hydrocarbons, nitrogen, and nitrous oxide. Selection of the propellant depends largely on the nature of the other chemicals used and the pressure needed.

Compressed gases and volatile liquids are sometimes used as foaming agents for plastics materials such as polyethylene, polystyrene, and polyurethanes. As the plastics material is polymerized or processed, the gas vaporizes and gives a spongelike, cellular structure to the finished material, making it useful for flotation, insulation, and upholstery padding. Halogenated hydrocarbons used as foaming agents include methylchloride and several fluorocarbons. Other chemicals used as foaming agents include hydrocarbons and nitrogenous compounds. The selection of the foaming agent depends on the plastic to be foamed, the processing applied, and the use for which the finished material is intended.

Liquids and solids which are easily vaporized are often used for fumigation. Halogenated hydrocarbons used as fumigants for plants and soil include methyl bromide; 1,2-dibromo-3-chloropropane; 1,3-dichloropropene; and tetrachloroethane. Those used as fumigants for grains and textiles include ethylene dichloride, carbon tetrachloride, and ethyl chloride. Other chemicals used as fumigants include carbon

disulfide, dichlorobenzene, hydrogen cyanide, naphthalene, and acrylonitrile. The selection depends on the susceptibility of the pest to be fumigated, the toxicity of the fumigant to the user, and the conditons of use.

Liquid halogenated hydrocarbons are neutral solvents for many chemicals and materials which are insoluble in water or aqueous solutions. The most widely used are the "chlorinated solvents" (principally methylene chloride, perchloroethylene, trichloroethylene, and 1,1,1-trichloroethane). In extractive and degreasing operations, they are preferred for their low flammability and toxicity and for the ease with which they may be separated from the other materials. A variety of cleaning formulations consisting of mixtures of chlorinated solvents with aliphatic or aromatic hydrocarbons, detergents, and other chemicals are prepared for textiles, ceramics, metal parts or machinery, and other industrial and household uses. In large-volume applications where recovery and re-use of the solvent is desirable, a single stabilized solvent is generally preferred. In drycleaning, for example, perchloroethylene is the chlorinated solvent now used, having almost completely replaced the carbon tetrachloride and trichloroethylene formerly used.

Halogenated hydrocarbons containing a double bond, principally vinyl chloride, vinylidene chloride, and tetrafluoroethylene, are easily polymerized to plastics and resin materials. The resins produced from them are competitive in some applications with polyethylene and other thermoplastic resins.

Some halogenated hydrocarbons are used as intermediates in the synthesis of different halogenated hydrocarbons or other organic chemicals. Among these are ethylene dichloride (for vinyl chloride), carbon tetrachloride (for fluorocarbons), chloroform (for fluorocarbons), ethyl chloride (for tetraethyl lead), and tetrachloroethane (for perchloroethylene and trichloroethylene).

Still other uses for halogenated hydrocarbons are in pharmaceuticals, fire extinguishers, hydraulic fluids, antiknock preparations for gasoline, and lubricants.

Process of manufacture

Halogenated hydrocarbons are produced principally by the reaction between a hydrocarbon (from petroleum or natural gas) and a halogen. They are also obtained from carbon disulfide, alcohols, and halogen acids.

Chlorine (item 415.20), a poisonous gas, is by far the most important of the halogen raw materials. It is derived as a coproduct with caustic soda by electrolysis of sodium chloride. The profitable utilization of chlorine in production of chlorinated hydrocarbons is of particular importance to the balance of the chlorine-caustic soda production.

In the synthesis of halogenated hydrocarbons, chlorine may be used in its elemental form or (less frequently) in the form of hydrochloric acid (item 416.15), which is obtained as a byproduct by several producers of halogenated hydrocarbons and other synthetic organic chemicals. Hydrochloric acid may be used in direct synthesis as in the esterification of ethyl alcohol to produce ethyl chloride and in the hydrochlorination of acetylene to produce vinyl chloride. It may also be electrolyzed back to elemental chlorine, or it may be used in an oxychlorination process where the oxygen, hydrochloric acid, and hydrocarbon are reacted in a single system to produce a chlorinated compound. The cost of chlorine is substantially lower when it is obtained as coproduct hydrochloric acid than when purchased on the open market, but the supply is more limited.

Fluorine is usually used in the form of hydrofluoric acid (item 416.20) obtained by the reaction of sulfuric acid with fluorspar. When the hydrofluoric acid is reacted with a chlorinated hydrocarbon, the fluorine displaces the chlorine to form a fluorinated compound. Many commercial fluorocarbon compounds contain both chlorine and fluorine.

Bromine (item 415.05), a poisonous gas, is more expensive and less important than chlorine and fluorine in the halogenation of hydrocarbons. Bromine is obtained by the treatment with chlorine of inorganic bromine compounds occurring in very small percentages in certain natural brines or sea water. It is used in the form of liquefied elemental bromine or as hydrobromic acid.

Iodine (items 415.25 and 415.27), like bromine, is obtained from brine. Its derivatives with hydrocarbons are the most expensive and least used in the group.

The most important hydrocarbon raw materials are those containing one or two carbon atoms--methane, acetylene, and ethylene. Methane (item 429.52) is obtained from cracking petroleum naptha or from natural gas. Its most important halogen derivatives are carbon tetrachloride and methylene chloride. Acetylene (item 429.52) was once obtained only from calcium carbide derived by electric-furnace reaction of coal and limestone, but increasingly large amounts are now obtained from petroleum. The most important halogen derivatives of acetylene are trichloroethylene, perchloroethylene, and vinyl chloride. Ethylene (item 429.50) is obtained from refinery gases, from natural gas, or by

cracking petroleum naphtha. Its principal halogen derivatives are ethylene dichloride, ethyl chloride, and ethylene dibromide.

The raw materials used are poisonous, flammable, or gaseous chemicals, the transportation of which is expensive. Therefore, large production units are often established as part of a chemical complex at a location where the basic raw materials are readily available. Within the complex, materials for the synthesis of halogenated hydrocarbons and other important petrochemicals are frequently exchanged between firms by pipe lines or by barge at a much lower cost than is reflected in commercial quotations.

U.S. tariff treatment

Under the Tariff Act of 1930 and earlier acts, the halogenated hydrocarbons which were then commercially important were scattered under various paragraphs under heterogeneous tariff rates. When the tariff schedules of the United States were revised in 1963, the related compounds were brought together, but the rates of duty were unchanged. The rates of duty and their ad valorem equivalents are given in the individual summaries which follow.

U.S. producers

More than 50 companies produce halogenated hydrocarbons in the United States. There are many producers of the leading items but only one or two producers of the numerous individual specialties included. Some producers are small independent concerns. The producers of the principal items, however, and the major producers of the total are large integrated companies. The producers in 1966 are listed by product, as follows: 1/

U.S. producers of halogenated hydrocarbons, by TSUS item

TSUS item	Halogenated hydrocarbon and producer
420.20	Ethylene dichloride: American Chem; Diamond Shamrock; Dow; duPont; Ethyl Corp.; B.F. Goodrich; Jefferson; Monsanto; Olin Mathieson; Pittsburgh Plate Glass; Union Carbide.
	Propylene dichloride: Dow, Jefferson; Union Carbide.
429.22	Carbon tetrachloride: Allied (General Div. and Solvay Div.); Diamond Shamrock; Dow; Food Machinery; Frontier; Pittsburgh Plate Glass; Stauffer.
429.24	Chloroform: Allied (Solvay Div.); Diamond Shamrock; Dow, duPont; Frontier; Stauffer.

See footnote at end of tabulation.

GENERAL STATEMENT ON HALOGENATED HYDROCARBONS

U.S. producers of halogenated hydrocarbons, by TSUS item--Continued

TSUS item	Halogenated hydrocarbon and producer
429.26	Ethyl chloride: American Chemical; Dow; duPont; Hercules; Ethyl Corp.; Pittsburgh Plate Glass; Shell; U.S. Industrial.
429.28	Ethylene dibromide: Dow; Ethyl-Dow; Houston Chemical; Michigan Chemical.
420.30	Hexachloroethane: Nease.
429.32	Methylene chloride: Allied Chemical; Diamond Shamrock; Dow; duPont; Frontier; Hooker; Stauffer.
429.34	Perchloroethylene: Detrex; Diamond Shamrock; Dow; duPont; Frontier; Hooker; Pittsburgh Plate Glass; Stauffer.
429.38	Tetrachloroethane: duPont.
429.42	Trichloroethylene: Detrex; Dow; duPont; Hooker; Pittsburg Plate Glass.
429.44	Vinyl chloride: Allied Chemical; American Chemical; Borden; Cumberland; Diamond; Dow; Ethyl Corp; General Tire; B.F. Goodrich; Goodyear; Monochem; Monsanto; Union Carbide.
429.46	Vinylidene chloride: Dow; Ethyl Corp.
429.47	Other:
	Chlorinated paraffins: Diamond Shamrock; Dover; Hercules; Hooker; Keil; Koppers; Neville; Pearsall.
	Chloromethane: Allied Chemical; Ancon; Diamond Shamrock; Dow; Dow Corning; duPont; Ethyl Corp.; Union Carbide.
	3-Chloropropene: Dow; Shell.
	1,1,1-Trichloroethane: Dow; Ethyl Corp.; Pittsburgh Plate Glass.
	Other: Columbia; Dow; duPont; Eastman Kodak; Food Machinery; Hooker; Koppers; Eli Lilly; Phillips Petroleum; Publicker; Roberts; Union Carbide.
429.48	Other:
	Bromomethane: American Potash; Dow; Great Lakes; Michigan Chemical; Vulcan.
	Bromine compounds; other: Abbott Labs.; American Potash; Benzol Products; Best Fertilizer; Columbia; Dow; duPont; Eastman Kodak; General Aniline; I.C.I.; Eli Lilly; Michigan Chemical; Shell; Sterling Drug; Upjohn.

See footnote at end of tabulation.

U.S. producers of halogenated hydrocarbons, by TSUS item--Continued

TSUS item	Halogenated hydrocarbon and producer
429.48	Fluorocarbons, 11, 12, 14: Allied Chemical; duPont; Kaiser Aluminum; Pennsalt; Union Carbide.
	Containing bromine: Dow; duPont; I.C.I.
	Unsaturated: Allied Chemical; duPont; Hooker; Minnesota Mining and Manufacturing.
	Other: Allied Chemical; duPont; Pennsalt.
	Iodine compounds: Columbia; Eastman Kodak; Fairmount; National Biochemical; R.S.A. Corp.; Sterling Drug.

1/ U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales, 1966, TC Publication 248, 1968.

The producers include both long-established producers of snythetic organic chemicals (such as duPont, Union Carbide, and Monsanto) and firms originally engaged in a different field of manufacture. Dow began as the first commercial producer of bromine. Other companies (such as Hooker, Pittsburgh Plate Glass, and Diamond Shamrock) first produced sodium chloride (salt) and other inorganic chemicals and entered into production of halogenated hydrocarbons as an outlet for their chlorine production. Such companies generally produce compounds containing a high percentage of chlorine, such as carbon tetrachloride (92 percent chlorine), chloroform (89 percent), perchloroethylene (86 percent), methylene chloride (83 percent), and trichloroethylene (81 percent).

Shell is a petroleum company which began production of halogenated hydrocarbons as a diversification of its hydrocarbon production. Still other producers, including Ethyl Corporation, General Tire, B.F. Goodrich, and Goodyear, are users which integrated backwards into halogenated hydrocarbons. Several, as Jefferson and Ethyl-Dow, are joint ventures between companies of diverse backgrounds.

U.S. consumption and production

U.S. consumption of halogenated hydrocarbons (including both intermediates and finished products) exceeded 7 billion pounds, valued at $1.5 billion, in 1966 (table 1). Imports and exports were equivalent to about 3 percent of the quantity of consumption in that year.

Production has increased both through expansion of capacity by existing producers and through the coming into existence of new producers. A slow, steady growth has occurred in the output of compounds

whose use has been long-established, such as ethyl chloride, an intermediate for the tetraethyl lead used as a gasoline additive. A more rapid growth has occurred in the production of compounds having applications in housing and other building--such as vinyl chloride (and its precursor, ethylene dichloride)--for flooring, upholstery, and molded products. Production of fluorocarbons (and their precursors), used in refrigerants and aerosol propellants, has also experienced rapid growth. Production of halogenated hydrocarbons, by kind, is shown in table 2. The compounds produced in greatest volume in 1966 were ethylene dichloride (3.6 billion pounds), vinyl chloride (2.5 billion pounds), ethyl chloride (677 million pounds), and carbon tetrachloride (648 million pounds).

The large volume chemicals are generally manufactured in a large specialized plant producing only one or two chemicals, and the relatively expensive specialties are manufactured in establishments which use batch-process methods.

Volume sales of halogenated hydrocarbons for further chemical synthesis are generally made directly between chemical companies, but sales of end products (such as solvents, fumigants, refrigerants, and propellants) are frequently made through distributors.

U.S. exports

Annual U.S. exports of halogenated hydrocarbons averaged 284 million pounds, valued at $24 million, in 1965-67 (table 3) and went to many countries. The principal European destinations were the Netherlands and Belgium-Luxembourg, where several U.S. producers have affiliates. Part of these exports were probably intended for further manufacture and for shipment to other European countries. Other important markets were Mexico, Canada, and Japan.

In 1967, 95 percent of exports consisted of chlorine derivatives, and 5 percent, of fluorine derivatives, on a quantitative basis, whereas 72 percent consisted of chlorine derivatives and 28 percent, of fluorine derivatives, on a value basis.

U.S. imports

Annual U.S. imports of halogenated hydrocarbons averaged 181 million pounds, valued at $12.8 million, in 1964-67 (table 4). The principal sources were Italy, France, the United Kingdom, and West Germany, none of which was a major market for U.S. exports of these products.

U.S. imports of halogenated hydrocarbons, by kind, are given in table 5. Trichloroethylene and perchloroethylene, which have been the largest items imported, accounted for 87 percent of the volume of imports in 1967. These are not the principal halogenated hydrocarbons consumed in the United States. However, they are dutiable at the lowest rates and are end products, used by a large number of customers that are not themselves chemical producers.

The importers include not only small operators but also affiliates of large foreign producers that offer storage facilities and technical services. There is seldom any difference in quality between imported and domestic products.

Foreign production and trade

Halogenated hydrocarbons are produced in nearly every industrialized country, generally by the principal chemical concerns. Many of the producers are basic in petroleum, sodium chloride, or another important raw material. The major U.S. producers manufacture abroad through their subsidiaries and affiliates, but they do not account for a large share of the foreign production.

Production of vinyl chloride (and its precursor, ethylene dichloride) and of dichlorodifluoromethane and trichlorofluoromethane (and their precursor, carbon tetrachloride) is most widely distributed. It occurs in the smaller industrialized nations as well as in large nations having well-established petroleum or chemical industries. Production of the chlorinated solvents--perchloroethylene and trichloroethylene--and of the variety of specialized halogenated hydrocarbons is largely confined to the European nations, Japan, Canada, and the United States.

Table 1.--Halogenated hydrocarbons: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1964-67

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Imports	Exports 2/	Apparent consumption	Ratio (percent) of imports to consumption
			Quantity		
1964	5,261,533	176,367	3/	3/	3/
1965	6,160,066	158,383	304,844	6,013,605	2.6
1966	7,120,583	221,835	221,228	7,121,190	3.1
1967	3/	164,959	328,336	3/	3/
			Value		
1964	4/ 735,743	12,286	3/	3/	3/
1965	4/ 877,841	11,536	24,246	865,131	1.3
1966	4/ 1,067,713	15,804	22,778	1,060,739	1.5
1967	3/	11,747	26,185	3/	3/

1/ Excludes production of carbon tetrachloride, chloroform, and ethylene dichloride as they are principally consumed in the production of other chemicals which are included in the total.

2/ Does not include exports of ethylene dibromide or other bromides, but such exports are probably small.

3/ Not available. 4/ Computed from the unit value of sales.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Halogenated hydrocarbons: U.S. production, by kinds, 1962-66

Kind	1962	1963	1964	1965	1966
	Quantity (million pounds)				
Ethylene dichloride	1,774	1,793	2,199	2,456	3,617
Propylene dichloride	35	35	58	61	76
Carbon tetrachloride	484	519	536	594	648
Chloroform	98	10	119	153	179
Ethyl chloride	537	592	666	686	677
Ethylene dibromide 1/	191	199	238	281	270
Methylene chloride	144	148	180	210	267
Perchloroethylene	320	325	366	429	463
Trichloroethylene	356	368	370	435	480
Vinyl chloride	1,311	1,435	1,615	2,000	2,500
Chlorinated only 2/	147	152	174	231	540
Fluorinated, brominated, and iodinated 3/	387	431	453	531	548
Not published separately 4/	1,043	1,200	1,204	1,313	1,324
Total 5/	6,824	7,207	8,138	9,380	11,589
	Value (million dollars) 6/				
Ethylene dichloride	88	90	110	110	145
Propylene dichloride	1	1	2	1	2
Carbon tetrachloride	30	42	38	42	45
Chloroform	9	9	10	12	14
Ethyl chloride	38	47	47	48	47
Ethylene dibromide 1/	38	39	54	65	63
Methylene chloride	13	13	16	19	27
Perchloroethylene	32	33	33	34	37
Trichloroethylene	36	33	33	35	38
Vinyl chloride	92	100	97	120	150
Chlorinated only 2/	16	16	16	19	200
Fluorinated, brominated, and iodinated 3/	119	130	150	161	169
Not published separately 4/	189	237	326	372	346
Total 5/	710	790	902	1,038	1,283

1/ Consists of sales; includes small quantities of other bromides.

2/ Includes only chlorinated paraffins and chloromethane for 1962-65; includes also 1,1,1-trichloroethane for 1966.

3/ Includes only bromomethane, chlorodifluoromethane, 1,2-dibromo-3-chloropropane, dichlorodifluoromethane, dichlorotetrafluoroethane, and trichlorofluoromethane.

4/ Includes hexachloroethane, tetrachloroethane, vinylidene chloride, and small quantities of items covered elsewhere in the TSUS.

5/ Includes some duplication, owing to conversion between chemicals.

6/ Value of production computed from unit value of sales.

Source: Ethylene dibromide, U.S. Bureau of Mines, Minerals Yearbook; others, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Halogenated hydrocarbons: U.S. exports of domestic merchandise, by principal markets, 1965-67

Market	1965	1966	1967
	Quantity (1,000 pounds)		
Mexico	59,119	73,059	89,729
Netherlands	101,472	66,953	112,498
Canada	13,979	29,528	20,883
Japan	1,750	1,282	39,578
Belgium-Luxembourg	928	1,143	2,730
Australia	9,577	3,878	8,749
Union of South Africa	1,657	2,621	4,946
Venezuela	1,683	2,687	3,187
Colombia	2,291	6,379	9,208
All other	112,388	33,698	36,828
Total	304,844	221,228	328,336
	Value (1,000 dollars)		
Mexico	4,702	5,754	6,615
Netherlands	6,354	3,581	5,892
Canada	1,811	3,200	2,192
Japan	570	621	1,951
Belgium-Luxembourg	430	587	1,391
Australia	687	579	816
Union of South Africa	314	457	648
Venezuela	402	490	593
Colombia	192	475	549
All other	8,784	7,034	5,538
Total	24,246	22,778	26,185

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Halogenated hydrocarbons: U.S. imports for consumption by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Italy	36,022	40,933	52,188	51,556
France	39,020	29,972	48,735	39,929
United Kingdom	47,857	40,006	35,000	18,117
West Germany	22,626	11,059	23,337	27,383
Canada	2,644	9,412	10,621	7,775
Belgium-Luxembourg	19,948	18,657	14,642	5,841
Poland	-	-	1,660	6,519
Netherlands	426	1,302	6,052	4,101
Japan	5,247	6,559	28,681	2,876
All other	2,577	483	919	854
Total	176,367	158,383	221,835	164,951
	Value (1,000 dollars)			
Italy	2,346	2,611	3,334	3,386
France	2,933	2,234	3,424	2,858
United Kingdom	3,678	3,327	3,212	1,856
West Germany	1,376	762	1,668	1,621
Canada	224	853	844	721
Belgium-Luxembourg	1,189	1,134	945	388
Poland	-	-	83	354
Netherlands	26	67	452	239
Japan	366	460	1,693	226
All other	148	88	149	98
Total	12,286	11,536	15,804	11,747

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Halogenated hydrocarbons: U.S. imports for consumption, by kind, 1964-67

Kind	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Butylene dichloride, ethylene dichloride, and propylene dichloride	-	10	2	1
Carbon tetrachloride	7,856	10,033	10,682	4,979
Chloroform	-	1/	3	-
Ethyl chloride	2	2	1	2
Ethylene dibromide	-	-	519	185
Hexachloroethane	1,800	1,623	1,970	2,692
Methylene chloride	19,216	12,251	11,079	10,205
Perchloroethylene	70,031	50,082	67,912	49,959
Trichloroethylene	75,742	79,986	118,952	93,263
Vinyl chloride	1,237	3,427	8,245	1,361
Vinylidene chloride	-	-	591	443
Chlorinated only	82	77	828	213
All other	401	892	1,051	1,648
	176,367	158,383	221,835	164,951
	Value (1,000 dollars)			
Butylene dichloride, ethylene dichloride, and propylene dichloride	-	1	2/	4
Carbon tetrachloride	429	515	491	226
Chloroform	-	1	1	-
Ethyl chloride	23	2	2	4
Ethylene dibromide	-	-	140	34
Hexachloroethane	183	162	186	263
Methylene chloride	1,104	743	856	650
Perchloroethylene	4,744	3,590	4,493	3,410
Trichloroethylene	5,169	5,438	7,767	5,952
Vinyl chloride	95	257	629	101
Vinylidene chloride	-	-	72	48
Chlorinated only	20	33	159	34
All other	539	794	1,008	1,021
Total	12,286	11,536	15,804	11,747

1/ Less than 500 pounds.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Butylene dichloride, ethylene dichloride, and propylene dichloride	429.20

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

In 1967 the United States consumed 4.0 billion pounds of ethylene dichloride, valued at $160 million, 86.3 million pounds of propylene dichloride, valued at $2.6 million, and a much smaller amount of butylene dichloride. Imports and exports of these products were probably negligible.

Description and uses

Butylene dichloride (1,2-dichlorobutane), ethylene dichloride (1,2-dichloroethane), and propylene dichloride (1,2-dichloropropane) are colorless heavy liquids obtained by the reaction of chlorine with the corresponding unsaturated hydrocarbon (olefin)--butylene (C_4H_8), ethylene (C_2H_4), propylene (C_3H_6). Ethylene dichloride, by far the most important of the three, is also made by oxychlorination of ethylene. Propylene dichloride is also obtained as a byproduct in the conversion of propylene chlorohydrin to propylene oxide.

The ethylene dichloride molecule (CH_2ClCH_2Cl) may be cracked to yield a molecule of vinyl chloride ($CH_2=CHCl$) and a molecule of hydrochloric acid (HCl). About two-thirds of the ethylene dichloride produced is used in the production of the vinyl chloride monomer from which polyvinyl chloride and copolymer plastics and resins are made. Ethylene dichloride at present is the chief route to vinyl chloride, although an alternative route, the hydrochlorination of acetylene, is still used extensively.

Ethylene dichloride has a variety of uses other than as a source of vinyl chloride monomer. It serves as a fumigant, a solvent, a scavenger for lead in antiknock preparations, and as an intermediate for ethylenediamine, vinylidene chloride, 1,1,1-trichloroethane, and other chemicals.

Propylene dichloride is used as an intermediate for carbon tetrachloride and perchloroethylene and as a lead scavenger for antiknock fluids. Butylene dichloride, of much less importance, is used as a solvent and as chemical intermediate in the manufacture of other chemicals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.20	Butylene dichloride, ethylene dichloride, and propylene dichloride.	3¢ per lb. + 15% ad val.	1.5¢ per lb. + 7.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Vinyl chloride (item 429.44), for which ethylene dichloride is an intermediate, was dutiable at 2.5¢ per pound plus 12.5 percent ad valorem prior to January 1, 1968, and will be dutiable at 1.25¢ per pound plus 6 percent ad valorem on January 1, 1972.

U.S. producers

Ethylene dichloride was produced in 1967 by 11 firms at 14 locations--six in Texas, four in Louisiana, two in Kentucky, and the others in California, and West Virginia. Three of the same firms produce propylene dichloride at five locations--two of them in Texas, and the others in Louisiana, Michigan, and West Virginia. The producers are large integrated firms producing chlorinated hydrocarbons and a variety of other products. Seven of the 11 producers of ethylene dichloride also produce the vinyl chloride for which it is used.

U.S. consumption, production, imports, and exports

U.S. consumption of these chlorinated hydrocarbons is equivalent to production, since imports or exports are negligible. Production of ethylene dichloride increased from 1.4 billion pounds in 1961 to 2.2 billion in 1964 and to 4.0 billion in 1967 (table 1), and that of propylene dichloride increased from 37.7 million pounds in 1961 to 86.3 million in 1967 (table 2). Butylene dichloride is not produced in commercially significant volume.

Sales of ethylene dichloride (291 million pounds, valued at $21 million, in 1966) accounted for less than one-tenth of production, and those of propylene dichloride (31 million pounds, valued at $729,000, in 1965), for somewhat more than half of production.

Table 1.--Ethylene dichloride: U.S. production and sales, 1961-67

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per Pound
1961	1,368,467	442,747	20,941	$0.05
1962	1,774,345	294,960	13,681	.05
1963	1,793,335	325,600	14,788	.05
1964	2,199,378	445,508	20,671	.05
1965	2,455,907	309,033	13,932	.04
1966	3,616,599	291,029	12,261	.04
1967	3,970,756	324,031	12,636	.04

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Propylene dichloride: U.S. production and sales, 1961-67

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per Pound
1961	37,746	22,442	766	$0.03
1962	35,467	23,771	743	.03
1963	35,539	27,475	666	.02
1964	58,489	32,294	816	.03
1965	61,013	31,122	729	.02
1966	76,283	1/	1/	1/
1967	86,275	28,843	740	.03

1/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Commodity	TSUS item
Carbon tetrachloride--------	429.22

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Carbon tetrachloride is an important halogenated hydrocarbon used principally as an intermediate in the production of fluorocarbons. U.S. production amounted to 714 million pounds in 1967. Imports and exports generally amount to less than 2 percent of consumption.

Description and uses

Carbon tetrachloride is a colorless, nonflammable, volatile, heavy liquid. Much of the carbon tetrachloride produced is sold for use as an intermediate in the synthesis of the aerosol propellants--dichlorodifluoromethane and trichlorofluoromethane (item 429.48). Although carbon tetrachloride has been used as a fire-extinguisher fluid, in grain fumigation, and for a variety of small solvent applications, the continued inhalation of the fumes has been found to be physically harmful, so that it is being largely replaced in such uses by safer compounds.

Carbon tetrachloride is produced principally by the reaction of chlorine with methane, a reaction which produces not only carbon tetrachloride (CCl_4), but also the three other chloromethanes--methyl chloride (CH_3Cl, item 429.47), methylene chloride (CH_2Cl_2, item 429.32), and chloroform ($CHCl_3$, item 429.24). The reaction may be controlled to vary the proportion of different chloromethanes formed. Carbon tetrachloride is also obtained by the chlorination of carbon disulfide and, in much smaller amounts, as a byproduct in the production of perchloroethylene (item 429.34).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.22	Carbon tetrachloride----	0.65¢ per lb.	0.32¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on carbon tetrachloride was 8.3 percent; it was 7.4 percent for the rate in effect on January 1, 1968.

U.S. producers

Carbon tetrachloride was produced in 1967 by seven firms at 11 plants, two each in Ohio and West Virginia, and the others in Alabama, California, Kansas, Kentucky, Louisiana, New York, and Texas. It was produced at six of the locations by chlorination of methane where the coproducts methylene chloride and chloroform were obtained; at four methyl chloride, was also obtained. At two locations, carbon tetrachloride was produced from carbon disulfide without obtaining chloromethanes as coproducts. At several locations, a small quantity of carbon tetrachloride was obtained as a byproduct of perchloroethylene production.

The producers are large integrated firms generally producing the necessary chlorine raw material by electrolysis of sodium chloride. All produce at least a few other organic chemicals besides carbon tetrachloride, and several produce large volumes of inorganic chemicals.

The producers sell a major portion of the carbon tetrachloride they make. Although none are completely dependent on carbon tetrachloride as a source of income, the profitable utilization of this product is necessary for the economical operation of the integrated plant facilities.

U.S. production, exports, and imports

U.S. production of carbon tetrachloride, which is practically equivalent to consumption, increased from 484 million pounds, valued at $39 million, in 1962, to 594 million pounds, valued at $42 million, in 1965, and 714 million pounds, valued at $43 million in 1967 (table 1). Much of the production is sold, the major part of it to five

firms which produce dichlorodifluoromethane and trichlorofluoromethane. The increase in production reflects the growing use of these chemicals.

Statistics on U.S. exports were last published for 1964, when exports amounted to 10.5 million pounds, valued at $680,000, and were several times as large as in previous years. Of the total, 9.8 million pounds, valued at $588,000, went to the Netherlands, where several U.S. producers have their European affiliates.

U.S. imports totaled 7.9 million pounds in 1964, or only 1.5 percent of consumption. They declined to 5 million pounds in 1967 and came chiefly from West Germany and Italy (table 2).

Table 1.--Carbon tetrachloride: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1962-67

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production 1/	Imports	Exports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity				
1962	483,673	4,500	1,026	487,147	0.9
1963	519,168	2,543	210	521,501	.5
1964	535,891	7,856	10,524	533,223	1.5
1965	593,636	10,033	2/	2/	2/
1966	647,959	10,682	2/	2/	2/
1967	713,599	4,979	2/	2/	2/
	Value				
1962	38,694	358	112	38,940	.9
1963	41,533	129	43	41,619	.3
1964	37,502	429	680	37,251	1.1
1965	41,555	515	2/	2/	2/
1966	45,357	491	2/	2/	2/
1967	42,840	226	2/	2/	2/

1/ Values estimated on the basis of unit value of sales.
2/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Carbon tetrachloride: U.S. imports for consumption, by principal sources, 1963-67

Source	1963	1964	1965	1966	1967
	Quantity (1,000 pounds)				
West Germany	15	4,137	-	-	4,766
Italy	988	3,144	7,723	5,601	193
Japan	-	11	109	4,566	20
Belgium	375	438	1,101	515	-
All other	1/ 1,165	126	1,100	2/	-
Total	2,543	7,856	10,033	10,682	4,979
	Value (1,000 dollars)				
West Germany	1	213	-	-	215
Italy	53	178	397	246	9
Japan	-	1	7	220	2
Belgium	19	21	56	25	-
All other	1/ 56	16	55	3/	-
Total	129	429	515	491	226

1/ All from France.
2/ Less than 500 pounds.
3/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Chloroform----------	429.24

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Chloroform is produced in conjunction with other chloromethanes and used principally as an intermediate for fluorocarbons. U.S. production totaled 191 million pounds, valued at $15 million, in 1967. Imports and exports are small compared with production.

Description and uses

Chloroform is a colorless, nonflammable, heavy, volatile liquid. By far the greatest part of the chloroform produced is sold by the producers for use as an intermediate chemical in the synthesis of chlorodifluoromethane (item 429.48) which, in turn, is used as a refrigerant, as a propellent for aerosols, and as an intermediate for fluorocarbon plastics. A much smaller part of the chloroform produced is used in grain fumigants and as a solvent for dyes, perfumes, and natural products. Less than 1 percent of the chloroform produced is of the U.S.P. grade for use in cough medicines, linaments, and other pharmaceuticals.

Chloroform is produced by the reaction of chlorine with methane. The process forms not only chloroform ($CHCl_3$) but also the three other chloromethanes--methyl chloride (CH_3Cl, item 429.47), methylene chloride (CH_2Cl_2, item 429.32), and carbon tetrachloride (CCl_4, item 429.22). The conditions of the reaction may be controlled to vary the proportion of each chloromethane formed. A relatively new process is the oxychlorination of methane, which forms methyl chloride and methylene chloride as coproducts with chloroform.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.24	Chloroform------	4¢ per lb.	2¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. producers

Chloroform was produced in 1967 by six firms at eight plants--two in West Virginia, and one each in California, Kansas, Kentucky, New York, New Jersey, and Texas.

The producers are large integrated firms which generally produce the chlorine raw material by electrolysis of sodium chloride. All produce at least a few other organic chemicals, and several produce large volumes of inorganic chemicals.

All the producers obtain chloroform by the chlorination or oxychlorination of methane. Three producers obtain the three other chloromethanes as coproducts. Two obtain methylene chloride and carbon tetrachloride as coproducts, and one obtains methyl chloride and methylene chloride as coproducts. Four producers sell almost all the chloroform they produce, and the two others transfer most of their output to other divisions of the same firms for use in the manufacture of other products.

U.S. production, imports, and exports

U.S. production of chloroform, which is equivalent to consumption, increased steadily from 98 million pounds, valued at $8.8 million, in 1962 to 191 million pounds, valued at $15.3 million, in 1967 (see table). About three-fourths of the chloroform produced is sold to nonaffiliated firms, and most of the remainder is shipped to affiliates. The major users, whether affiliated or not, are the five producers of chlorodifluoromethane.

The largest importation of chloroform in recent years was 6,660 pounds, valued at $364, from Italy in 1961. The unit value of imports has ranged from 6 cents per pound to $175 per pound. The exceptionally high unit value may represent either a research quality product or a misclassification.

Chloroform: U.S. production and imports for consumption, 1962-67

Year	Production		Imports	
	Quantity	Value 1/	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1962	98,209	8,839	2/	3/
1963	105,149	9,463	2/	1
1964	119,210	9,537	-	-
1965	152,510	12,210	2/	1
1966	178,953	14,316	3	1
1967	190,886	15,274	-	-

1/ Value of production calculated using the unit value of sales.
2/ Less than 500 pounds.
3/ Less than $500.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Statistics on exports of chloroform are not available; exports, if any, are small.

Commodity	TSUS item
Ethyl chloride--------	429.26

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reporduced in appendix A to this volume).

U.S. trade position

U.S. production of ethyl chloride in 1966 totaled 677 million pounds, valued at $47 million, almost all of which was consumed domestically in the production of tetraethyl lead. Imports and exports were negligible.

Description and uses

Ethyl chloride (also known as chloroethane) is a colorless, nonflammable volatile liquid. It serves largely as an intermediate chemical in the synthesis of tetraethyl lead (item 429.70) used in antiknock preparations for gasoline. Minor uses for ethyl chloride are as an intermediate for ethylcellulose plastics (item 445.25), or an ethylating agent for dyes and pharmaceuticals, as a solvent, and as a refrigerant. A very small quantity is produced as U.S.P. grade for anesthetic purposes. Ethyl chloride is produced principally by the reaction of hydrochloric acid with ethylene. Some is also produced by the reaction of chlorine with ethane, and by the reaction of hydrochloric acid with ethyl alcohol.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.26	Ethyl chloride--------	7.5¢ per lb.	3.7¢ per lb. 1/

1/ This rate, as well as those for 1970 and 1971, is contingent: see footnote 1 to Staged Rates and historical notes to part 2 of schedule 4 of the TSUSA-1969, as shown in appendix A to this volume.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, exports, and imports

In 1967, ethyl chloride was produced by seven firms in eight plants, three of them in Texas, two of them in Louisiana, and the others in California, New Jersey, and Virginia.

The producers are large companies generally producing a variety of organic chemicals derived from ehtylene or ethyl alcohol. Four of them use most of the ethyl chloride they produce in making tetraethyl lead and other chemicals. The other four sell their entire output.

U.S. production of ethyl chloride is equivalent to consumption. Production increased from 537 million pounds, valued at $38 million, in 1962 to 677 million pounds, valued at $47 million, in 1966. In that year over two-fifths of the production was sold and the remainder was used by the producers. Production in 1967 declined to 618 million pounds (see table).

U.S. exports are small or none. Imports in recent years, principally from West Germany, have been valued at $1 to $1.50 a pound and have apparently been of pharmaceutical grade. In 1961, however, 65,000 pounds, valued at $6,500 (10 cents a pound), was received from Canada.

Ethyl chloride: U.S. production, sales, and imports for consumption, 1962-67

Year	Production	Sales		Imports for consumption	
		Quantity	Value	Quantity	Value
	1,000 pounds	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1962	536,794	218,720	16,256	2	2
1963	591,847	233,731	17,550	1	2
1964	666,111	252,660	18,322	2	3
1965	685,768	273,944	18,576	2	2
1966	676,953	274,740	18,315	1	2
1967	618,183	284,644	19,166	2	4

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Statistics on exports of ethyl chloride are not available; exports are probably negligible.

Commodity	TSUS item
Ethylene dibromide--------	429.28

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. consumption of ethylene dibromide in antiknock preparations for gasoline exceeds 200 million pounds, valued at about $50 million; it is supplied almost entirely by domestic production.

Description and uses

Ethylene dibromide (also know as dibromoethane) is a poisonous liquid obtained by the reaction of bromine with ethylene. By far the major part of that produced is used with tetraethyl lead in antiknock preparations for gasoline, to volatilize the lead in the combustion chamber. The small remainder is used in soil and grain fumigation, as a chemical intermediate, and as a solvent.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.28	Ethylene dibromide----	2.4¢ per lb. + 12% ad val.	1.2¢ per lb. + 6% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967, on ethylene dibromide was 24.9 percent; it was 22.0 percent for the rate in effect on January 1, 1968.

U.S. production, exports, and imports

Ethylene dibromide was produced in 1967 by four companies at plants in Arkansas, Michigan, and Texas. The producers make most of their own bromine, but only one company produces a large variety of other synthetic organic chemicals.

Producers' sales (see table) are practically equivalent to consumption, since little is used by the producers themselves, and exprots and imports are small. The quantity of annual sales increased slowly during 1962-66 and averaged about 200 million pounds.

The largest imports in recent years were 519,000 pounds, valued at $140,000, from West Germany and Israel in 1966.

Ethylene dibromide: U.S. sales by primary producers, and imports for consumption, 1962-67

Year	Sales 1/		Imports	
	Quantity	Value	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1962	190,903	38,034	8	2
1963	198,845	39,095	-	-
1964	237,750	54,061	-	-
1965	281,211	64,529	-	-
1966	270,504	63,299	519	140
1967	2/	2/	185	34

1/ Includes from 5 to 10 percent of sodium bromide, ammonium bromide, and potassium bromide.

2/ Not available.

Source: Sales, U.S. Bureau of Mines, Minerals Yearbook; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Statistics are not available on U.S. exports of ethylene dibromide, but exports are probably less than 5 percent of production.

Commodity	TSUS item
Methylene chloride---------	429.32

Note.--For the statutory description see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced as appencix A to this volume).

U.S. trade position

Methylene chloride is an important chlorinated solvent. Its use has increased rapidly in recent years. In 1967 production of methylene chloride was 262 million pounds; imports were 10.2 million pounds. Exports were probably small.

Description and uses

Methylene chloride (also known as dichloromethane) is a colorless, nonflammable, heavy, volatile liquid with an agreeable odor. More than half of that produced is used as a solvent in preparations for stripping paint. The remainder is used for degreasing, as an aerosol propellant, and as asolvent in the production of plastic films and cements.

Methylene chloride is produced by the reaction of chlorine with methane. Production forms not only methylene chloride (CH_2Cl_2), but also the three other chloromethanes--methyl chloride (CH_3Cl), chloroform ($CHCl_3$), and carbon tetrachloride (CCl_4). The conditions of the reaction may be controlled to vary the proportions of the chloromethanes formed. A relatively new process for production of chloromethanes is the oxychlorination of methane.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.32	Methylene chloride----	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS) through 1967.

U.S. producers

Methylene chloride was produced in 1967 by six firms in eight plants, two of which were in West Virginia, and the other six in California, Kansas, Kentucky, New York, New Jersey, and Texas. Two plants are reported to use methanol as a raw material, and remainder to use methane. The producers are large integrated firms which generally produce the chlorine raw material from sodium chloride. All produce other organic chemicals, and several produce large quantities of inorganic chemicals. Three producers obtain the three other chloromethanes as coproducts; two others obtain as coproducts only carbon tetrachloride and chloroform; and one obtains chloroform and methyl chloride.

U.S. production and exports

With the growing use of methylene chloride for removing paint for household, industrial, and military purposes, production has increased rapidly. In comparison with 89 million pounds in 1958, 116 million pounds was produced in 1961, 267 million, in 1966, and 262 million pounds in 1967 (table 1). Producers' sales increased from 88 million pounds, valued at $10 million, in 1958 to 227 million pounds, valued at $20 million, in 1967. Most of the production is sold by the producers, generally to firms that are not producers of chemicals. Exports of methylene chloride are not separately reported.

U.S. imports

Imports of methylene chloride were first reported in official statistics for 1964, when they totaled 19 million pounds, valued at $1.1 million. They decreased slowly to 10 million pounds, valued at $650,000, in 1967. West Germany and Italy have been the principal sources of supply (table 2).

Table 1.--Methylene chloride: U.S. production, sales, and imports for consumption, 1962-67

Year	Production	Sales		Imports	
		Quantity	Value	Quantity	Value
	1,000 pounds	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1962	143,787	128,723	11,899	1/	1/
1963	147,950	133,249	12,307	1/	1/
1964	179,602	156,693	14,020	19,216	1,104
1965	210,830	194,504	17,207	12,251	743
1966	267,213	225,833	22,494	11,079	856
1967	262,285	226,913	20,037	10,205	650
1968	2/ 273,774	1/	1/	14,456	856

1/ Not available.
2/ Preliminary.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Statistics on exports of methylene chloride are not available; exports are probably less than 5 percent of production.

Table 2.--Methylene chloride: U.S. imports for consumption, by principal sources, 1964-68

Source	1964	1965	1966	1967	1968
	Quantity (1,000 pounds)				
West Germany	9,984	5,606	7,458	4,856	5,778
Italy	6,325	5,396	1,565	4,606	6,708
Belgium	1,034	948	321	660	1,817
Japan	132	245	1,679	83	110
United Kingdom	1,741	56	-	-	41
All other	-	-	56	-	2
Total	19,216	12,251	11,079	10,205	14,456
	Value (1,000 dollars)				
West Germany	613	345	568	311	411
Italy	327	320	108	280	331
Belgium	61	58	23	51	94
Japan	9	17	154	8	17
United Kingdom	94	3	-	-	2
All other	-	-	3	-	1
Total	1,104	743	856	650	856

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Perchloroethylene	429.34

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Perchloroethylene is an important chlorinated solvent, used in drycleaning, vapor degreasing, and as an intermediate. Production in 1967 was 533 million pounds, with sales of 467 million pounds, valued at $36 million. In that year, imports were equivalent to 9 percent of production, and exports are believed to have been less than imports.

Description and uses

Perchloroethylene (also known as tetrachloroethylene) competes in drycleaning with Stoddard solvent, an aliphatic petroleum naphtha which is lower priced but flammable. Use of nonflammable perchloroethylene permits drycleaning establishments to operate in densely populated areas. Since 1960, coin-operated, self-service drycleaning establishments using perchloroethylene have come into general use. Perchloroethylene is also used as an intermediate for fluorocarbon synthesis and for vapor degreasing.

Perchloroethylene is produced chiefly by the simultaneous chlorination and cracking of mixed hydrocarbons and propylene dichloride. Hydrochloric acid, carbon tetrachloride, and other chlorinated methanes are also formed in the reaction. The reaction conditions may be controlled to vary the proportion of different chlorinnated hydrocarbons produced.

In a second method, acetylene is chlorinated to form tetrachloroethane, which is then dehydrochlorinated to form trichloroethylene. The trichloroethylene may be withdrawn from the reaction system and sold, or it may be further chlorinated and dehydrochlorinated to perchloroethylene.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.34	Perchloroethylene----------	6% ad val.	3% ad val. 1/

1/ This rate, as well as those for 1970 and 1971, is contingent: see footnote 1 to staged rates and historical notes to part 2 of schedule 4 of the TSUSA-1969, as shown in appendix A to this volume.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. producers

In 1967 perchloroethylene was produced by nine firms with 14 plants, five in Louisiana, two each in Ohio and Texas, and the others in California, Kansas, Kentucky, New York, and Washington. Two producers are among the largestUU.S. chemical firms. Six firms produce perchloroethylene largely in connection with their chlorine output. One is primarily a manufacturer of industrial and commercial cleaning machinery and materials.

In the process of manufacture, four producers of perchloroethylene obtain also trichloroethylene and one or more chlorinated methanes; two obrain only trichloroethylene; and three obtain also several chlorinated methanes but no trichloroethylene. Although they all make the chlorine, most of the producers purchase the hydrocarbons used.

Most of the output is sold by the producers, principally to distributors for ultimate sale to numerous drycleaning establishments.

U.S. production, exports, and imports

With the growing use in drycleaning, production of perchloroethylene (table 1) increased steadily from 187 million pounds, valued at $20 million, in 1958 to 320 million pounds, valued at $31 million, in 1962 and 533 million pounds, valued at $43 million, in 1967. U.S. exports are not separately reported but are believed small.

Imports increased from 10 million pounds in 1958 (equivalent to 5 percent of production) to 70 million pounds (equivalent to 16 percent of production) in 1964, and then declined to 50 million pounds (equivalent to 9 percent of production) in 1967. The price of the imported material, before duty (6 percent) and other costs of importation, averaged 2.7¢ per pound below the domestic price of 10.4¢ per pound in 1960 and 1.5¢ per pound below the domestic price of 8.1¢ per pound in 1966 (table 1). France, Italy, and Canada have been the chief sources of imports (table 2).

Foreign production and trade

Perchloroethylene is produced in most of the industrialized nations. At least 17 firms produce perchloroethylene in Western Europe, and several produce it in Japan. The foreign producers are generally large integrated chemical firms. One in Canada is an affiliate of a large U.S. producer.

Table 1.--Perchloroethylene: U.S. production and imports for consumption, 1962-68

Year	Production			Imports		
	Quantity	Value 1/	Unit value	Quantity	Value	Unit value
	1,000 pounds	1,000 dollars	Cents per pound	1,000 pounds	1,000 dollars	Cents per pound
1962	319,694	30,763	9.6	45,663	3,336	7.3
1963	325,054	30,880	9.5	57,537	4,225	7.3
1964	365,729	34,378	9.4	70,031	4,744	6.8
1965	429,354	36,066	8.4	50,082	3,590	7.2
1966	462,678	37,477	8.1	67,912	4,493	6.6
1967	532,980	43,173	2/ 8.1	49,959	3,410	6.8
1968	631,048	58,056	2/ 9.2	44,270	2,940	6.6

1/ Calculated from unit value of sales.
2/ Estimated.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Exports of perchloroethylene are not separately reported, but are believed to be small.

Table 2.--Perchloroethylene: U.S. imports for consumption, by principal sources, 1963-67

Source	1963	1964	1965	1966	1967
	Quantity (1,000 pounds)				
France	17,517	25,380	17,249	25,768	23,402
Italy	12,463	13,733	9,265	11,037	8,959
Canada	2,355	1,406	5,962	2,372	5,531
West Germany	2,310	3,495	1,435	8,122	4,794
Belgium	8,881	14,946	8,937	10,754	2,549
United Kingdom	7,346	6,320	4,217	3,249	2,162
Netherlands	1,095	-	-	3,518	2,366
Japan	5,563	4,712	3,017	3,092	196
All other	9	-	-	-	-
Total	57,537	70,031	50,082	67,912	49,959
	Value (1,000 dollars)				
France	1,331	1,799	1,246	1,738	1,600
Italy	923	995	648	748	592
Canada	226	128	594	217	504
West Germany	138	217	88	490	263
Belgium	715	903	567	705	167
United Kingdom	470	398	264	204	136
Netherlands	71	-	-	209	136
Japan	350	303	183	182	12
All other	1/	-	-	-	-
Total	4,225	4,744	3,590	4,493	3,410

1/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Trichloroethylene	429.42

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of trichloroethylene in 1967 totaled 490 million pounds, with an estimated value of $41 million; imports of 93 million pounds were equivalent to 19 percent of production. Exports are believed to be considerably smaller than imports.

Description and uses

Trichloroethylene is a volatile nonflammable liquid used principally in vapor degreasing metal parts and machinery. The cold metal is suspended over warmed trichloroethylene in an enclosure. The liquid vaporizes readily and is condensed on the metal, where it dissolves the grease and drops back in a continuous operation. The chemical is also used to extract natural products, such as caffeine from coffee or grease from wool, and as a solvent in prepared mixtures.

In the production of trichloroethylene, acetylene is first chlorinated to form tetrachloroethane, which is then dehydrochlorinated to form trichloroethylene.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.42	Trichloroethylene	7.5% ad val.	3.5% ad val. 1/

1/ This rate, as well as those for 1970 and 1971, is contingent; see footnote 1 to staged rates and historical notes to part 2 of schedule 4 of the TSUSA-1969, as shown in appendix A to this volume.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of

trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, exports, and imports

In 1967 trichloroethylene was produced by six firms at nine plants--four in Louisiana, two in New York, and the others in Ohio, Texas, and Washington. Two of the firms are among the largest U.S. producers of synthetic organic chemicals. Several produce trichloroethylene principally in connection with their chlorine output. One is a manufacturer of industrial and commercial cleaning machinery and materials. The producers all make chlorine used in the synthesis of trichloroethylene, but most of them purchase the hydrocarbons used.

The quantity of production increased with increasing activity in the metal-fabricating industries, from 295 million pounds in 1958 to 370 million in 1964 and 490 million in 1967. The value of production declined from $37 million in 1958 to $32 million in 1964, as the unit value declined. It then increased to $41 million in 1967, as the unit value remained firmer (table 1).

Imports increased from 35 million pounds, valued at $3 million in 1958, when they accounted for 11 percent of the consumption, to 93 million pounds, valued at $6 million, in 1967, when they accounted for 19 percent. In 1958-63, imports were valued, before duty and other costs of importation, about 3 cents a pound less than the domestic product, but the difference narrowed in 1964.

The imports are obtained chiefly from Italy, France, and the United Kingdom (table 2). Output abroad is large, particularly in Europe, where several of the principal chemical firms are producers.

Table 1.--Trichloroethylene: U.S. production and imports for consumption, 1962-68

Year	Production			Imports		
	Quantity	Value 1/	Unit value	Quantity	Value	Unit value
	1,000 pounds	1,000 dollars	Cents per pound	1,000 pounds	1,000 dollars	Cents per pound
1962	356,062	35,606	10.0	64,959	4,654	7.2
1963	368,179	33,136	9.0	71,164	4,795	6.7
1964	370,465	32,230	8.7	75,742	5,169	6.8
1965	434,510	36,499	8.4	79,986	5,438	6.8
1966	480,219	40,338	8.4	118,952	7,767	6.5
1967	489,964	41,442	8.4	93,263	5,952	6.4
1968	2/ 513,878	3/	3/	58,704	3,180	5.4

1/ Values calculated using the unit value of sales.
2/ Preliminary.
3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Note.--Exports are probably small and are not separately reported.

Table 2.--Trichloroethylene: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Italy	12,780	18,548	33,986	37,796
France	12,488	11,951	22,089	15,224
United Kingdom	39,183	34,947	30,594	14,415
West Germany	4,844	3,819	6,898	12,244
Poland	-	-	1,660	6,519
Belgium	3,531	7,670	3,052	2,632
Japan	280	2,872	18,883	2,283
Netherlands	426	147	1,760	1,735
Canada	-	31	12	412
All other	2,210	1	18	3
Total	75,742	79,986	118,952	93,263
	Value (1,000 dollars)			
Italy	846	1,246	2,232	2,505
France	869	831	1,534	1,061
United Kingdom	2,803	2,498	2,178	914
West Germany	299	246	419	689
Poland	-	-	83	354
Belgium	202	453	184	153
Japan	17	151	1,028	136
Netherlands	26	9	105	103
Canada	-	4	2	35
All other	107	-	2	2
Total	5,169	5,438	7,767	5,952

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Vinyl chloride--------	429.44
Vinylidene chloride---	429.46

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Vinyl chloride, one of the most important halogenated hydrocarbons, is the monomer from which polyvinyl chloride resins (TSUS 445.45) are made. U.S. production in 1967 was 2.4 billion pounds, valued at $150 million. Vinylidene chloride was produced in comparatively small volume. Imports and exports were negligible.

Description and uses

Vinyl chloride is a gas, and vinylidene chloride a colorless liquid. In an alkaline, aqueous medium, under controlled temperature and pressure, both polymerize to solid plastics materials. Polyvinyl chloride and its copolymers have a variety of applications, as in flooring materials, sheeting and films, paper and textile coatings, wire and cable covering, and molding materials. For some purposes, polyvinyl chloride may be used interchangeably with polyethylene plastics; in other uses the polyvinyl chloride is preferred because it is less flammable, more impervious to moisture, and more soluble in organic solvents. In addition to its use in plastics, vinyl chloride has a limited use as a chemical intermediate and propellant.

Polyvinylidene chloride is relatively expensive. It finds a limited use in self-adhesive films and coatings, where resistance to moisture, grease, or gas is required.

Vinyl chloride (CH_2=CHCl) is produced either by the direct addition of hydrochloric acid (HCl) to acetylene (CH≡CH) or by the removal of hydrochloric acid from ethylene dichloride (CH_2ClCH_2Cl). Several companies use a combination of processes wherein byproduct hydrochloric acid from ethylene dichloride is reacted with acetylene to form more vinyl chloride or with ethylene (by oxychlorination) to form more ethylene dichloride.

Vinylidene chloride ($CH_2=CCl_2$) is produced by the removal of hydrochloric acid from 1,1,2-trichloroethane ($CHCl_2CH_2Cl$) which, in turn, is derived by chlorination of ethylene dichloride.

U.S. tariff treatment

The column 1 (trade-agreement) rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.44	Vinyl chloride---	2.5¢ per lb. + 12.5% ad val.	1.25¢ per lb. + 6% ad val.
429.44	Vinylidene chloride.	2.5¢ per lb. + 12.5% ad val.	1.25¢ per lb. + 6% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, has remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalents of the rates of duty in effect on December 31, 1967, were 46.1 percent for vinyl chloride (item 429.44) and 35.6 percent for vinylidene chloride (item 429.46), while the corresponding equivalents of the rates in effect on January 1, 1968, were 39.8 percent for vinyl chloride and 32.6 for vinylidene chloride.

U.S. producers, production, and exports

Vinyl chloride was produced in 1967 by 14 firms at 20 locations--six in Texas, six in Louisiana, two each in Kentucky, New York, and West Virginia, and one each in California and Ohio. Two of the 14 firms are producers of vinylidene chloride. The producers are generally large firms that produce a variety of other synthetic organic chemicals; many are basic in making acetylene and ethylene. Several producers of finished rubber products entered the plastics field through their interests in high polymers, and integrated backwards to vinyl chloride monomer. Although most of the producers have separate facilities for monomer polymerization, many sell part of the monomer production to smaller plastics processors.

U.S. consumption of vinyl chloride and vinylidene chloride approximates production since imports and exports are relatively small. U.S. production of vinyl chloride increased rapidly from 0.7 billion pounds in 1958 to 1.3 billion pounds in 1962 and 2.5 billion pounds in

1966 (see table). Two-thirds of the vinyl chloride monomer produced in 1966 was used by the producers to make the polymer. Sales amounted to 836 million pounds, valued at $50 million, in 1966. Advances in technology, particularly in oxychlorination, have contributed to a decline in the average unit value of sales from 11 cents per pound in 1958 to 7 cents in 1963 and 6 cents in 1966. This, in turn, has contributed to a lower price for vinyl plastics and a growing use of them.

U.S. imports

Statistics on imports of vinyl chloride or vinylidene chloride are not available for the years prior to 1964, and no vinylidene chloride was imported in 1964 or 1965. Imports in 1964-67 are given below. 1/

Year and product	Quantity (1,000 pounds)	Value (1,000 dollars)	Principal source (value basis)
1964:			
Vinyl chloride------	1,238	95	Canada
1965:			
Vinyl chloride------	3,427	257	Canada
1966:			
Vinyl chloride------	8,245	629	Canada
Vinylidene chloride----------	591	72	West Germany
1967:			
Vinyl chloride------	1,361	101	Canada
Vinylidene chloride----------	443	48	West Germany
1968:			
Vinyl chloride------	58	13	Sweden
Vinylidene chloride----------	545	59	Netherlands

1/ Compiled from official statistics of the U.S. Department of Commerce.

Vinyl chloride: U.S. production and sales, 1962-68

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1962	1,311,489	515,522	38,548	$0.07
1963	1,435,209	500,812	34,966	.07
1964	1,614,981	597,124	37,895	.06
1965	2,000,000	687,817	42,178	.06
1966	2,499,549	836,172	49,552	.06
1967	2,423,572	951,695	50,172	.05
1968	1/ 2,642,207	2/	2/	2/

1/ Preliminary.
2/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Commodity	TSUS item
Hexachloroethane	429.30
Tetrachloroethane	429.38
Hydrocarbons, chlorinated but not otherwise halogenated and not elsewhere enumerated	429.47

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. production of the chemicals covered in this summary is estimated to be almost a billion pounds and to be valued at almost $100 million. Exports are probably about 10 percent of production. Imports of hexachloroethane account for much of the limited consumption, but those of the other chemicals included are small or none.

Description and uses

This summary covers hexachloroethane, tetrachloroethane, and hydrocarbons which have been chlorinated, but not otherwise halogenated and which are not separately listed. The most important of those not separately listed are chloromethane, chlorinated paraffins, 3-chloropropene, and 1,1,1-trichloroethane.

Hexachloroethane is a white crystalline solid obtained by the addition of chlorine to perchloroethylene. It is used for organic synthesis, as a retarding agent in fermentation, as a rubber accelerator, and in pyrotechnics and smoke devices.

Tetrachloroethane is produced by the chlorination of acetylene. Hydrochloric acid is formed as a byproduct. Virtually all the production is used by the producers in the synthesis of perchloroethylene and trichloroethylene.

Chloromethane (also known as methyl chloride) is produced either by the esterification of methyl alcohol with hydrochloric acid or by the chlorination of methane. It is used as an intermediate chemical in the synthesis of silicones, butyl rubber, tetramethyl lead, and methylcellulose.

Chlorinated paraffins are produced by chlorinating paraffinic hydrocarbons--generally straight-chain compounds containing from 10 to 30 carbon atoms. The degree of chlorination varies widely--products containing 35 to 64 percent chlorine account for about three-fourths of the total. Most chlorinated paraffins are viscous liquids or low-melting waxlike solids. Their greatest use as in plastics, where they extend the use of the more expensive plasticizers and decrease the flammability of the product. Other uses are as extreme pressure lubricant additives and in textile treatment.

3-Chloropropene (also known as allyl chloride) is produced by the reaction of chlorine on propylene, with hydrochloric acid as a byproduct. It serves as an intermediate in the synthesis of other intermediates, such as glycerol, allyl alcohol, and epichlorohydrin, which, in turn, are used to make plastics materials, medicinals, and a variety of end products.

1,1,1-Trichloroethane (also known as methylchloroform) is a chlorinated solvent preferred for cold cleaning, particularly of electrical machinery. Although it is higher priced than carbon tetrachloride and trichloroethylene, it is less toxic in continued use and has been replacing these older solvents in many applications.

Other chlorinated hydrocarbons consist principally of mono-, di-, and tri-chloro derivatives of straight and branched chain hydrocarbons containing two or six carbon atoms and are used for a variety of purposes, including chemical intermediates and solvents.

U.S. tariff treatment

The column 1 (trade-agreement) rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Halogenated hydrocarbons:		
429.30	Hexachloroethane----------	10.5% ad val.	5% ad val.
429.38	Tetrachloroethane----------	15% ad val.	7.5% ad val.
429.47	Hydrocarbons, chlorinated but not otherwise halogenated and not elsewhere enumerated.	3¢ per lb. + 115% ad val.	1.5¢ per lb. + 7.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The

first of five annual stages of the reductions became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1967, the average ad valorem equivalent of the rate of duty in effect on December 31, 1967 on hydrocarbons chlorinated but not otherwise halogenated and not elsewhere enumerated (item 429.47) was 35.1 percent; for the rate in effect on January 1, 1968, it was 29.5 percent.

U.S. production and exports

Only one company produced hexachloroethane in 1966. Although several companies obtain tetrachloroethane during the production of perchloroethylene, it is seldom isolated from the reaction system. Including both large diversified companies and small specialty companies, nine concerns produce chloromethane; eight, chlorinated paraffins; three, 1,1,1-trichloroethane; and about 20, other chlorinated hydrocarbons.

U.S. production of the aggregate of the items covered in this summary is estimated to have been about 1 billion pounds in 1966. Of this amount, 243 million consisted of 1,1,1-trichloroethane, 237 million consisted of chloromethane, and 60 million, of chlorinated paraffins, the only categories for which the information is separately reported. Exports are not separately reported but are believed to average about 10 percent of production.

Production of chloromethane increased from 108 million pounds in 1962 to 276 million pounds in 1967 (table 1). Sales increased between these years from 46 million pounds, valued at $4.4 million (10 cents a pound), to 118 million pounds, valued at $8.0 million (7 cents a pound). Production of chlorinated paraffins increased from 38 million pounds in 1963 to 60 million pounds in 1966 (table 2). Sales increased over the same period from 38 million pounds, valued at $4.8 million, to 61 million pounds, valued at $7.9 million.

U.S. imports

U.S. imports of the chlorinated hydrocarbons covered by this summary amounted to 2 million pounds, valued at $200,000, in 1964 and increased to 3 million pounds, valued at $300,000, in 1967. Nine-tenths of the total consisted of hexachloroethane, which came principally from France, Spain, and the United Kingdom and supplied a substantial part of U.S. consumption of this chemical (table 3). Tetrachloroethane has not been imported since 1960, when 30 million

pounds, valued at $1.3 million, was entered from Italy. Annual imports of the other chlorinated hydrocarbons covered by this summary averaged 300,000 pounds, valued at $61,000 during 1964-67 (table 4) and were negligible in comparison with U.S. production.

Table 1.--Chloromethane (methyl chloride): U.S. production and sales, 1962-67

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1962	107,715	46,216	4,427	$0.10
1963	114,042	54,718	4,741	.09
1964	134,011	67,199	5,233	.08
1965	187,549	94,791	6,437	.07
1966	236,889	104,224	7,473	.07
1967	275,617	118,031	7,970	.07

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Chlorinated paraffins: U.S. production and sales, 1963-67

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Cents per pound
1963	37,939	37,764	4,836	12
1964	39,887	1/	1/	1/
1965	43,750	43,635	5,698	13
1966	60,051	60,734	7,936	13
1967	56,693	54,596	6,787	12

1/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Hexachloroethane: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
France	1,111	663	785	1,210
Spain	241	343	420	650
United Kingdom	300	418	591	526
Canada	-	-	-	154
West Germany	148	143	77	141
Japan	-	-	77	11
Netherlands	-	56	-	-
All other	-	-	20	-
Total	1,800	1,623	1,970	2,692
	Value (1,000 dollars)			
France	114	70	78	120
Spain	23	31	39	59
United Kingdom	30	42	53	46
Canada	-	-	-	21
West Germany	16	16	8	16
Japan	-	-	6	1
Netherlands	-	3	-	-
All other	-	-	2	-
Total	183	162	186	263

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Hydrocarbons, chlorinated but not otherwise halogenated and not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Japan	50	72	105	101
United Kingdom	30	5	-	79
Canada	-	-	-	24
West Germany	2	-	5	9
Netherlands	-	-	718	-
Switzerland	1/	-	-	-
Total	82	77	828	213
	Value (1,000 dollars)			
Japan	16	23	24	18
United Kingdom	2	10	-	11
Canada	-	-	-	3
West Germany	1	-	1	2
Netherlands	-	-	134	-
Switzerland	1	-	-	-
Total	20	33	159	34

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Halogenated hydrocarbons, not elsewhere enumerated	429.48

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of the halogenated hydrocarbons covered in this summary is more than half a billion pounds a year and has been increasing. U.S. exports are several times as large as imports, but both are small in relation to production.

Description and uses

The halogenated hydrocarbons included here are those (whether or not chlorinated) containing fluorine, bromine (except ethylene dibromide, item 429.28), and iodine. More than 50 of these compounds are produced commercially. Fluorinated hydrocarbons (known as fluorocarbons) are by far the most important; the brominated hydrocarbons are next in importance; and the iodinated hydrocarbons are of minor importance.

The saturated fluorocarbons are commercially designated by numerals in which the last digit represents the number of fluorine atoms; the next to the last digit represents the number of hydrogen atoms plus 1; and the third from the last digit represents the number of carbon atoms minus 1. The principal compounds in this group are chlorodifluoromethane (F-22), produced from chloroform; dichlorodifluoromethane (F-12) and trichlorofluoromethane (F-11), both produced from carbon tetrachloride; and dichlorotetrafluoroethane (F-114), produced from perchloroethylene. They are used mostly as refrigerants in air conditioners and as aerosol propellants. In addition F-22 is used as a plastics intermediate, and F-11 is used as a foaming agent for plastics.

Unsaturated fluorocarbons, principally chlorotrifluoroethylene, hexafluoropropylene, and tetrafluoroethylene, are polymerized to resins peculiarly resistant to chemicals, heat, and electricity. The resins are used as parts and coating for equipment exposed to corrosive chemicals, in textile finishes to impart stain resistance, in coatings to prevent food from sticking to cooking utensils, and as high-temperature lubricants. Fluorocarbons containing bromine, such as

bromotrifluoromethane and dibromodifluoromethane, are used in fire extinguishers.

Bromomethane (or methyl bromide), the principal brominated compound, and 1,2-dibromo-3-chloropropane are used as fumigants. Bromomethane and monobromine derivatives of higher hydrocarbons are used as intermediates in the synthesis of pharmaceuticals and other chemicals. Although more costly than their chlorine counterparts, they are more reactive and less volatile.

U.S. tariff treatment

The column 1 (trade-agreement) rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969 are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Halogenated hydrocarbons:		
429.48	Other----------	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production

In 1966, fluorocarbons were produced by seven firms at 13 locations, two each in California, Kentucky, Louisiana, and New Jersey, and the others in Illinois, Indiana, Kansas, Michigan, and West Virginia. With the increased use of aerosol propellants and refrigerants, production has increased rapidly. In 1967 production included 310 million pounds of dichlorodifluoromethane (F-12), 86 million pounds of dichlorotetrafluoroethane (F-114), and 182 million pounds of trichlorofluoromethane (F-11) (table 1). Production of the unsaturated fluorocarbons is large and has been increasing.

Bromomethane is produced by five companies, most of which make bromine. Production increased from 13 million pounds in 1962 to 16 million pounds in 1966. The remaining products in the group are made

not only by the large producers of halogenated hydrocarbons discussed in preceding summaries, but also by several small and medium-sized producers of pharmaceuticals and research chemicals. The total volume of production is not available for publication, but both the volume and the number of chemicals included has been increasing.

U.S. exports

U.S. exports of organo-fluorine compounds (virtually all fluorocarbons) are widely distributed. They increased from 15.4 million pounds, valued at $5.9 million, in 1962 to 17.5 million pounds, valued at $7.3 million, in 1967 (table 2). Although U.S. production of the four large publishable fluorocarbons increased 40 percent from 1962 to 1966, U.S. exports of all fluorocarbons increased only 17 percent during the same period. Exports of brominated and iodinated hydrocarbons are small and are not separately reported.

U.S. imports

U.S. imports of fluorinated, brominated, and iodinated hydrocarbons increased rapidly from 400,000 pounds, valued at $539,000, in 1964 to 1,647,000 pounds, valued at $1,020,000, in 1967 (table 3) but remained small in comparison with production and exports. They included chlorotrifluoroethane, bromochlorodifluoromethane, and bromopropane from the United Kingdom; 3-bromopropyne and fluorocarbons from France; fluorocarbons from West Germany; and fluorocarbons 11, 12, and 113, and hexafluoropropylene from Japan.

Table 1.--Brominated and fluorinated hydrocarbons: U.S. production, by kinds, 1962-66

Kind	1962	1963	1964	1965	1966
	Quantity (1,000 pounds)				
1-Bromobutane (n-Butyl bromide)	58	53	43	69	1/
Bromomethane (Methyl bromide)	12,757	17,394	16,994	14,303	16,345
Chlorodifluoromethane (F-22) 2/	29,473	36,006	43,380	49,815	49,476
1,2-Dibromo-3-chloropropane	1,545	4,268	5,314	1/	1/
Dichlorodifluoromethane (F-12)	207,960	217,433	227,873	271,408	286,326
Dichlorotetrafluoroethane (F-114)	10,521	11,612	13,401	21,762	2/17,870
Trichlorofluoromethane (F-11)	124,757	140,130	148,496	170,461	170,350
	Value (1,000 dollars) 3/				
1-Bromobutane (n-Butyl bromide)	45	43	1/	51	1/
Bromomethane (Methyl bromide)	5,613	6,610	7,140	6,293	6,701
Chlorodifluoromethane (F-22) 2/	19,747	23,764	27,093	30,193	31,691
1,2-Dibromo-3-chloropropane	850	2,049	2,391	1/	1/
Dichlorodifluoromethane (F-12)	60,308	63,056	66,083	75,994	83,034
Dichlorotetrafluoroethane (F-114)	6,419	6,851	8,041	12,622	2/10,477
Trichlorofluoromethane (F-11)	26,199	28,026	31,184	34,092	34,070

1/ Not available.
2/ Sales; production data are not available.
3/ Computed from unit value of sales.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Organo-fluorine compounds: U.S. exports of domestic merchandise, by principal markets, 1962-67

Market	1962	1963	1964	1965	1966	1967
	Quantity (1,000 pounds)					
Belgium	818	419	624	928	1,143	2,730
Canada	917	1,153	839	1,205	331	520
Venezuela	1,055	1,532	1,574	1,260	2,082	2,577
Japan	183	376	609	795	745	982
West Germany	852	1,161	1,277	1,053	2,963	811
Republic of South Africa	1,090	616	689	794	951	1,191
Australia	1,063	876	947	667	539	638
Hong Kong	178	216	253	303	307	633
Philippines	272	592	440	743	698	673
India	249	330	484	435	609	621
All other	8,688	7,896	7,736	6,545	7,667	6,159
Total	15,365	15,167	15,472	14,728	18,035	17,535
	Value (1,000 dollars)					
Belgium	285	182	301	430	587	1,391
Canada	514	779	619	464	346	547
Venezuela	293	391	378	337	426	537
Japan	105	158	225	355	415	531
West Germany	348	584	677	511	1,471	445
Republic of South Africa	367	216	229	261	302	365
Australia	337	287	293	283	257	325
Hong Kong	73	90	100	125	118	224
Philippines	116	180	135	227	197	198
India	83	123	166	183	207	195
All other	3,334	3,136	3,145	2,754	3,176	2,505
Total	5,855	6,126	6,268	5,930	7,502	7,263

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Fluorinated, brominated, and iodinated hydrocarbons: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
United Kingdom	282	361	566	933
France	41	109	88	94
West Germany	14	44	33	127
Canada	1/	2/	-	300
Japan	62	244	191	183
Israel	-	134	170	10
All other	1	1	1	1/
Total	400	893	1,049	1,647
	Value (1,000 dollars)			
United Kingdom	351	510	777	745
France	151	88	73	77
West Germany	15	63	37	72
Canada	3/	2/	-	59
Japan	19	79	62	49
Israel	-	53	53	2
All other	3	1	8	16
Total	539	794	1,010	1,020

1/ Less than 500 pounds.
2/ Not available.
3/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Butadiene, butylene, ethylene, and propylene	429.50
Other hydrocarbons	429.52

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

U.S. production of the hydrocarbons covered in this summary amounted to about 38 billion pounds in 1967; sales were 19.5 billion pounds, valued at $592 million. Imports in 1967 were 24.6 million pounds, valued at $3.1 million, or less than 1 percent of domestic output. Export statistics on these products are not available, but exports are believed to be smaller than imports.

Description and uses

Hydrocarbons are a class of chemicals which are composed of only the elements hydrogen and carbon. This summary includes four hydrocarbons specifically mentioned in the TSUS--butadiene, butylene, ethylene, and propylene--and all unspecified nonbenzenoid hydrocarbons such as acetylene, propylene, diisobutylene, dodecene, heptane, hexane, nonene, and octane. Benzenoid hydrocarbons, such as benzene, cumene, and styrene are covered in part 1 of schedule 4.

Butadiene, butylene, ethylene, and propylene are unsaturated hydrocarbons (i.e. containing fewer hydrogen atoms than their saturated counterparts with the same number of carbon atoms). The unenumerated hydrocarbons included in this summary consist of numerous products, both saturated and unsaturated. Most of the hydrocarbons are obtained from natural gas, or from the gas stream resulting from the cracking of crude petroleum. Only one hydrocarbon of importance is produced from other raw materials, that being acetylene, which is made by the action of water on calcium carbide, as well as from petroleum sources. These large-volume hydrocarbons are the raw materials from the manufacture of many organic chemicals and chemical products, among the most important of which are synthetic rubbers, plastics materials, chemical intermediates, antifreeze compounds, and manmade fibers.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Hydrocarbons:		
429.50	Butadiene, butylene, ethylene, and propylene	Free	Free
429.52	Other	10.5% ad val.	5% ad val.

The duty-free status of butadiene, butylene, ethylene, and propylene was provided for in the Tariff Act of 1930 and in the TSUS, effective August 31, 1963, and is bound in the General Agreement on Tariffs and Trade (GATT).

The rate applicable to other hydrocarbons effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The hydrocarbons covered by this summary which are derived from crude petroleum or natural gas are subject to import quota restrictions pursuant to Presidential Proclamation 3279 of March 10, 1959, as amended.

U.S. production and consumption

U.S. production and consumption of the hydrocarbons covered in this summary are approximately equal, since both exports and imports are relatively small. Production of the hydrocarbons covered here in 1964 was 27.3 billion pounds; sales amounted to 12.9 billion pounds, valued at $438.8 million. In 1967, production of these chemicals had increased to 38.0 billion pounds, with sales of 19.5 billion pounds, valued at $591.5 million. In terms of quantity produced in 1967, the most important hydrocarbons covered here were ethylene (11.9 billion pounds), propylene (5.8 billion pounds), and propane (4.1 billion pounds) (see table 1). A large part of the domestic output of hydrocarbons is used by the producers as the raw materials for the manufacture of finished products such as synthetic rubber and plastics materials.

U.S. producers

Hydrocarbons are produced in the United States by some 15 large chemical and rubber companies, and by about 20 major petroleum refineries. The major portion of the U.S. output of hydrocarbons comes from cracking plants of crude oil refineries, and from natural gas cycling plants. These refineries and cycling plants are located principally in the States of Texas and Louisiana in the south, along the upper Atlantic coast, and in California.

Exports and imports

Exports of the hydrocarbons included in this summary are not separately classified in the official statistics, except for acetylene. Exports of acetylene in 1967 were valued at $32,201. U.S. imports of butadiene, butylene, ethylene, and propylene increased from 7.7 million pounds, valued at $1.9 million in 1964 to 16.1 million pounds, valued at $2.7 million, in 1967 (table 2). These imports were principally from Canada. Imports of other hydrocarbons considered here totaled 6.7 million pounds, valued at $303,000 in 1964 and increased to 14.3 million pounds, valued at $970,000 in 1967 (table 3). In 1964-67, imports came principally from Trinidad, Norway, France, Canada, and West Germany.

Table 1.--Hydrocarbons: U.S. production and sales, 1967

Product	Production	Sales		
		Quantity	Value	Unit Value
	1,000 pounds	1,000 pounds	1,000 dollars	Cents per pound
Ethylene	11,854,515	3,353,371	132,560	4.0
Propylene	5,771,815	3,225,642	65,997	2.0
Butadiene	2,660,273	1,620,806	154,266	9.5
Isobutylene	1/	168,816	11,481	6.8
Acetylene 2/	429,464	1/	1/	
All other 3/	17,266,832	11,132,211	127,211	2.0
Total	37,982,899	19,500,846	591,515	3.0

1/ Not available.

2/ Represents acetylene from petroleum sources for chemical conversion. Data on acetylene from calcium carbide is published by the U.S. Bureau of the Census.

3/ Includes production of 34 million pounds of hydrocarbon derivatives, and sales of 22 million pounds valued at $5.7 million.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Butadiene, butylene, ethylene, and propylene: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Canada	6,028	11,508	16,630	16,112
United Kingdom	1,279	-	1/	-
France	337	775	-	-
All other	91	-	4	-
Total	7,735	12,283	16,634	16,112
	Value (1,000 dollars)			
Canada	1,216	1,915	2,628	2,715
United Kingdom	633	-	1	-
France	20	277	-	-
All other	8	-	5	-
Total	1,877	2,192	2,634	2,715

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Hydrocarbons not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Norway	162	88	181	332
France	35	6	19	3,892
Trinidad	6,455	2,764	4,330	7,556
Canada	5	121	989	2,451
West Germany	66	2,226	2,224	26
Italy	-	-	169	-
All other	5	1	49	1
Total	6,728	5,206	7,961	14,258
	Value (1,000 dollars)			
Norway	71	43	102	302
France	6	4	16	255
Trinidad	210	88	139	232
Canada	1/	4	50	162
West Germany	5	93	91	18
Italy	-	-	91	-
All other	11	8	7	1
Total	303	240	496	970

1/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Sulfur compounds, including thiols, sulfides, sulfoxides, and sulfones	429.60

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Annual U.S. consumption of organic sulfur compounds exceeds $50 million. Imports supply less than 5 percent of consumption. Exports are not separately classified.

Description and uses

Organic sulfur compounds covered by this summary include fewer than 25 compounds of commercial importance. Many are solvents, which are stronger or more selective than the halogenated or oxygenated solvents but limited for certain uses by a disagreeable odor and flammability. Some are used as gas odorants, oil additives, and rubber-processing chemicals and as intermediates in the synthesis of medicinals, feed supplements, dyes, and surface-active agents.

Thiols (also known as mercaptans) contain a bivalent sulfur atom attached to a carbon and a hydrogen atom; structurally they resemble alcohols in which a sulfur atom has replaced the oxygen atom. Tert-dodecyl mercaptan, the most important thiol, is used principally as a polymerization regulating agent for styrene-butadiene-rubber (SBR).

Sulfides contain a bivalent sulfur atom attached only to a carbon or another sulfur atom. Carbon disulfide (also known as carbon bisulfide), by far the most important of all organic sulfur compounds, is used principally in the production of viscose rayon and cellophane and as an intermediate in synthesizing carbon tetrachloride, which is, in turn, an intermediate for fluorocarbon chemicals.

Sulfoxides contain a tetravalent sulfur atom attached to one oxygen and two carbon atoms. Dimethyl sulfoxide, the most important sulfoxide, is used principally as a solvent for spinning synthetic fibers, especially polyacrylonitrile, and as a selective solvent for industrial cleaners and pesticides.

Sulfones contain a hexavalent sulfur atom which is attached to two oxygen and at least one carbon atom. Tetrahydrothiophene-1,1-dioxide

(also known as sulfolane), the most important sulfone, is used as a selective solvent in extracting aromatic hydrocarbons and purifying natural gas.

Governed by the TSUS order of precedence of function, the organic sulfur compounds classifiable under item 429.60 do not include those which contain an acid (or its salt), aldehyde, ketone, alcohol, ester, or epoxide function or a nitrogen atom. For example, derivatives of thiocarbamic acids are classifiable as nitrogen compounds (item 425.36) and mercaptoacetic acid is classifiable with other organic acids (item 425.98).

Carbon disulfide is made principally from sulfur and methane or, by an older process, from sulfur and charcoal. Other sulfides, and also thiols, are extracted from petroleum naphtha, natural gas, or paper-pulping wastes, or are prepared by controlled oxidation of sulfides and thiols. Cyclic sulfones, such as sulfolane, are made from butadiene and sulfur dioxide.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.60	Sulfur compounds, including thiols, sulfides, sulfoxides and sulfones.	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, consumption, and exports

U.S. consumption of organic sulfur compounds approximates production and was valued at about $50 million in 1966. Statistics on U.S. production in that year are available for only the two largest items--

carbon disulfide, valued at $30 million, and dodecyl mercaptan, valued at $6 million. Exports are not separately classified.

According to the Tariff Commission's reports on synthetic organic chemicals, annual production of carbon disulfide increased rapidly from 1962 to 1965. Production declined in 1966, and in 1967. Production of carbon disulfide for 1962-1967 is given in the following tabulation:

Year	Quantity (1,000 pounds)	Value (1,000 dollars)
1962	607,182	24,287
1963	652,021	26,081
1964	668,780	26,751
1965	756,512	30,260
1966	752,296	30,092
1967	693,638	27,745

Consumption of the carbon disulfide in cellophane production has grown only slowly because of greatly increased competition from other transparent films; consumption in rayon production has grown more rapidly, despite competition from newer synthetic fibers, while consumption in carbon tetrachloride production has grown the most rapidly. In 1967, carbon disulfide was produced by five firms at six plants--two in West Virginia and the others in Alabama, Delaware, Tennessee, and Texas. Most of the producers are large diversified companies that also make a variety of other organic and inorganic chemicals.

In 1967, dodecyl mercaptan was produced by three large diversified chemical companies. Production data for the years 1963-67 as reported by the Tariff Commission are shown in the following tabulation:

Year	Quantity (1,000 pounds)	Value (1,000 dollars)
1963	8,963	4,123
1964	10,249	4,407
1965	12,551	4,895
1966	12,658	5,823
1967	12,659	4,685

Other organic sulfur compounds were made in 1967 by a dozen firms, including a paper company, two rubber companies, and several petrochemical producers; production consisted principally of alkyl thiols,

alkyl sulfides, dimethyl sulfoxide and thiophene derivatives. Numerous other organo-sulfur chemicals were produced in developmental quantities.

U.S. imports

Statistics on U.S. imports of sulfur compounds are not available for the years prior to 1964. Imports increased rapidly from 178,000 pounds, valued at $139,000, in 1964 to 3.2 million pounds, valued at $1.0 million, in 1967 (see table). The increase was due principally to imports from the United Kingdom of tetrahydrothiophene-1,1-dioxide by the U.S. affiliate of a Dutch petroleum company (the principal U.S. supplier of organic sulfur compounds) for use in its aromatic refining operations. Imports of sulfur compounds from Canada have consisted principally of carbon disulfide imported from the Canadian affiliate of the major U.S. producer. In 1967 imports of carbon disulfide supplied less than 1 percent of U.S. consumption. Imports of sulfur compounds from West Germany and Japan have consisted principally of dodecyl mercaptan; in 1967 they supplied less than 1 percent of U.S. consumption.

Foreign production and trade

Carbon disulfide is produced in most of the industrialized countries of the world, but all such production is generally consumed in the producing country. The other organic sulfur compounds covered herein are produced principally in Europe and Japan.

Sulfur compounds, including thiols, sulfides, sulfoxides, and sulfones: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
United Kingdom	177	1/ 1,760	3,359	1,187
Netherlands	-	20	284	765
Canada	-	825	-	915
West Germany	2/	40	165	319
Japan	-	32	177	31
All other	1	1	2	3
Total	178	1/ 2,678	3,987	3,220
	Value (1,000 dollars)			
United Kingdom	98	1/ 877	1,471	625
Netherlands	-	3	118	323
Canada	-	28	-	41
West Germany	21	15	68	40
Japan	-	9	87	16
All other	20	2	3/	1
Total	139	1/ 939	1,744	1,046

1/ Imports are believed to have been understated by at least 1,158,000 pounds, valued at $689,000.
2/ Less than 500 pounds.
3/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Tetraethyl lead	429.70
Tetramethyl lead	429.85

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

In 1966, U.S. production of tetraethyl lead was 543 million pounds, valued at $293 million, and production of tetramethyl lead was 109 million pounds, valued at $57 million. There were no imports and probably no exports of these two compounds as such.

Description and uses

Tetraethyl and tetramethyl leads are heavy, colorless, oily, toxic liquids produced by the reaction of sodium-lead alloy with ethyl and methyl chlorides, respectively. They are used almost entirely in combination with the lead scavengers--ethylene dichloride and ethylene dibromide--to make antiknock compounds as additives to gasoline for use in internal combustion motors. A typical antiknock compound contains 61.5 percent tetraethyl or tetramethyl lead, 18.8 percent ethylene dichloride, and 17.9 percent ethylene dibromide. The related alkyl lead compounds--diethyl dimethyl lead, monoethyl trimethyl lead and monomethyl triethyl lead--are also used to make antiknock compounds, but these organic lead compounds are not included in this summary (see item 429.95--other organic compounds).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.70	Tetraethyl lead	15% ad val.	15% ad val. 1/
429.85	Tetramethyl lead	10.5% ad val.	10.5% ad val. 1/

1/ Rate of duty not affected by the Kennedy Round trade conference.

These rates, which reflect concessions granted by the United States in the General Agreement on Tariffs and Trade, have been in effect since January 1, 1948, for tetraethyl lead and since June 30, 1958, for tetramethyl lead. TSUS item 429.85 for tetramethyl lead was separately established as a result of the sixth round of trade negotiations, but the rate of duty applicable to tetramethyl lead was not changed. Item 429.90, where tetramethyl lead was previously covered, was deleted from the TSUS, and two new items--429.85 and 429.95--were established with a reduction in the rate of duty for item 429.95.

U.S. producers and production

Tetraethyl and tetramethyl leads are produced by four chemical companies in six plants--three in Texas and one each in New Jersey, Louisiana, and California. Domestic production of tetraethyl lead declined from 587 million pounds in 1964 to 543 million pounds in 1966; production in 1967 was 55 million pounds. Production of tetramethyl lead increased from 18 million pounds in 1962 to 109 million pounds in 1966; production in 1967 was 95 million pounds (table 1). Since both compounds are used for the same purpose, the increase in output of tetramethyl lead caused a decline in the production of tetraethyl lead.

U.S. imports and exports

There were no imports of tetraethyl lead from 1964-67 and probably none of tetramethyl lead. Statistics on exports of these compounds are not available separately but are included with the exports of chemicals as antiknock agents and exports of antiknock preparations. As production in foreign countries increased, exports of all antiknock chemicals and preparations declined in value from $40 million in 1965 to $34 million in 1967 (table 2).

Foreign production and trade

Tetraethyl and tetramethyl leads are produced in many of the industrial countries of Western Europe, especially in England, France, West Germany, and Italy; however, detailed production statistics are not available. There are also plants in Canada, Mexico and Japan. As in the United States, most of the import and export trade of foreign countries involve the finished antiknock preparations and not the individual tetraethyl and tetramethyl lead compounds.

Table 1.--Tetraethyl and tetramethyl lead: U.S. production and sales, 1962 and 1964-67 1/

Item and year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
Tetraethyl lead:				
1964	586,956	571,565	304,715	$0.53
1965	549,176	548,177	297,480	.54
1966	543,406	557,740	299,276	.54
1967	554,759	528,568	278,671	.53
Tetramethyl lead:				
1962	18,107	17,548	12,898	.74
1965 2/	137,609	136,038	78,001	.57
1966	109,328	95,648	49,865	.52
1967	94,921	97,587	44,420	.46

1/ Statistics on tetraethyl lead for years prior to 1964 and on tetramethyl lead for 1963 and 1964 are not publishable because publication would reveal the operations of individual companies.

2/ Figures for this year include some amounts of other alkyl leads, dimethyl diethyl lead, monomethyl triethyl lead, and monoethyl trimethyl lead.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Chemicals as antiknock agents, and antiknock preparations: U.S. exports of domestic merchandise, 1965-67

Year	Chemicals		Preparations	
	Quantity	Value	Quantity	Value
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1965	32,274	9,632	95,281	30,823
1966	11,243	3,407	99,630	31,499
1967	28,951	8,095	85,203	25,842

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Cellulose compounds, not specially provided for---	493.18

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Cellulose derivatives are widely used in domestic industry in the manufacture of filaments, sheeting and film, and plastics materials. U.S. production of these materials was about 1 billion pounds in 1967. The compounds of cellulose are not important commodities in international trade.

Description and uses

This summary covers the chemical derivatives of cellulose except carboxymethylcellulose salts and cellulose plastics materials (see separate summaries for TSUS items 465.87, 445.20, and 445.25). Included are the cellulose esters, namely cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, and nitrocellulose. Also covered are the cellulose ethers, the most important of which are methyl cellulose, ethyl cellulose, and hydroxyethyl cellulose. Other cellulose ethers covered are of relatively minor importance.

The cellulose esters of commercial importance are cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, and nitrocellulose, cellulose acetate being by far the most important. Cellulose acetate is a white, odorless material which is useful because of its characteristics of solubility and plasticity and because of the excellent coloring, clarity, stability, and attractiveness of the films and plastics products made from it. Cellulose acetate is prepared from purified cellulose and an acetylating mixture of acetic acid and acetic anhydride, with sulfuric acid as a catalyst.

Cellulose acetate is used chiefly in the manufacture of fibers for textiles, cigarette filters, and plastics materials and films. Cellulose acetate plastics have in recent years been displaced in many applications by lower cost synthetic polymers such as polystyrene, polyethylene, and polyvinyl chloride. The products of the mixed esters of cellulose acetate--namely, cellulose acetate butyrate and cellulose acetate propionate--have properties which are somewhat superior to those of cellulose acetate in some applications, and their use is therefore justified in spite of somewhat higher prices.

The cellulose mixed esters have found successful application as plastics materials for molded and extruded products and in the manufacture of film, sheeting, and lacquers.

Nitrocellulose is one of the oldest of the plastics materials. It is a good film former and therefore very useful in the manufacture of lacquers for protective and decorative coatings. Nitrocellulose is also used in flexible coatings for paper, foil, and plastics films, and in the manufacture of printing inks.

Of the cellulose ethers, methylcellulose was the most important in terms of quantity of production in 1966, followed by ethycellulose, hydroxyethylcellulose, and ethylhydroxyethyl cellulose. Methylcellulose is a white solid prepared by treating alkali cellulose with methyl chloride. Its principal uses are in ceramic glazes as a binder, in paper manufacture to impart wax and oil resistance, in the leather industry, and in the manufacture of pharmaceuticals, cosmetics, and foods.

Ethylcellulose is a white, granular solid prepared by treating alkali cellulose with ethyl chloride. It is used in protective lacquers for bowling pins, as a paper coating, and in the manufacture of adhesives and printing inks. Ethylcellulose also has uses as a plastics material in the form of films and extruded products.

Hydroxyethylcellulose is a white solid available in two types: water-soluble and water-insoluble. Water-soluble hydroxyethylcellulose is prepared from alkali cellulose and ethylene oxide or ethylene chlorohydrin. It is used as a thickener in latex paints and adhesives, in the emulsion polymerization of vinyl acetate, in portland cement to prevent water loss, and as a binder in nonwoven fabrics.

A number of other cellulose ethers of relatively little importance are covered in this summary. Among them are ethylhydroxyethylcellulose, methylhydroxypropycellulose, methylethylcellulose, and methylhydroxyethylcellulose. Carboxymethylcellulose salts (TSUS item 465.87) are covered in another summary.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general

headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
493.18 1/	Cellulose compounds, not specially provided for.	16¢ per lb.	8¢ per lb.

1/ This item added to TSUS, effective December 7, 1965. Former item 429.80 was deleted (Public Law 89-241, Oct. 7, 1965, 79 Stat. 933, 938).

The rate effective January 1, 1972, reflects the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent of the specific rate of duty on cellulose compounds in effect prior to January 1, 1968, based on imports in 1967, was 22.7 percent.

Production, consumption, and exports

U.S. production of cellulose acetate in 1967 amounted to 743 million pounds, with an estimated value of more than $200 million (see table 1). During the period 1961-66 production of cellulose acetate increased 40 percent. Trade sources estimate that about half of the cellulose acetate produced is used for fibers for textiles, about a fourth in cigarette filters, and the remainder, in plastics and films.

Production of all other cellulose esters and ethers (excluding cellulose acetate and sodium carboxymethylcellulose) in 1967 amounted to 232 million pounds, valued at about $100 million, compared with 195 million pounds, valued at about $84 million, in 1963 (table 1).

Imports are extremely small, and exports are believed to be quite small. It may therefore be assumed that domestic consumption of cellulose compounds approximates production. No official statistics on exports are available.

U.S. producers

In 1966 there were only seven companies--all very large chemical

companies--producing cellulose esters and ethers. For none of these companies was the production of cellulose compounds a major source of income; for most, a large portion of their production was utilized as captive consumption in the manufacture of fibers, films, and plastics materials.

Imports

Statistics on U.S. imports of cellulose compounds, not specially provided for, were not published separately for years before 1966. Imports of these materials in that year amounted to 397,000 pounds, valued at $266,000 (table 2), and consisted, for the most part, of methylcellulose, methylethylcellulose, ethylcellulose, and a few other miscellaneous items (e.g., wallpaper paste). In 1967, imports totaled 473,000 pounds, valued at $333,000. In both years imports came mainly from West Germany and the United Kingdom.

Foreign production and trade

There are few published statistics on world trade and production of these cellulose compounds, since these products are not important in world trade. The great bulk of foreign production is in Western Europe and Japan, with production being largely consumed by the producers.

Table 1.--Cellulose compounds, not specially provided for: U.S. production, 1963-67

(In thousands of pounds)

Year	Cellulose acetate	All other cellulose esters and ethers 1/		
		Total	Esters	Ethers
1963	603,736	195,205	158,419	36,786
1964	2/	203,859	162,984	40,875
1965	669,112	212,818	170,280	42,538
1966	750,304	227,023	179,826	47,197
1967	743,160	232,328	183,062	49,166

1/ Includes all cellulose esters and ethers except cellulose acetate and sodium carboxymethylcellulose.

2/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Cellulose compounds, not specially provided for: U.S. imports for consumption, by principal sources, 1966 and 1967

Source	1966	1967
	Quantity (pounds)	
United Kingdom	106,038	161,558
West Germany	250,843	198,906
Sweden	35,869	97,425
Greenland	-	15,000
France	-	300
Netherlands	4,691	-
Total	397,441	473,189
	Value	
United Kingdom	$ 89,683	$140,230
West Germany	151,154	131,342
Sweden	21,824	52,273
Greenland	-	9,216
France	-	270
Netherlands	3,580	-
Total	266,241	333,331
	Unit value (per pound)	
United Kingdom	$ .85	$ .87
West Germany	.60	.66
Sweden	.61	.54
Greenland	-	.61
France	-	.90
Netherlands	.76	-
Average	.67	.70

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Organic compounds not elsewhere enumerated----------	429.95

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

The value of annual U.S. production of organic compounds not elsewhere enumerated is estimated at $200 million. Annual imports, which have been increasing, are valued at $2.5 million to $3 million a year. Statistics on exports are included with those on numerous other commodities and cannot be separately identified.

General statement

The classification covered in this summary is the basket provision of schedule 4 for organic chemical compounds. Most other organic compounds are covered in other parts of the schedule by provisions such as those in part 1 for benzenoid compounds (including modified benzenoid and benzenoid-derived compounds, but excluding most natural benzenoid compounds), those in parts 3 through 13 for usage or derivation (such as medicinals, surface-active agents, perfume materials, and fatty substances), and those in part 2 for designated chemical functions (such as acids, aldehydes, and alcohols). The compounds which remain to be covered in this summary include organometallic compounds, phosgene, peroxides, metallic alcoholates, eucalyptol, and a variety of natural products and research chemicals.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
429.95	Organic compounds not elsewhere enumerated----------	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. Organic chemicals not elsewhere enumerated were covered by item 429.90 prior to January 1, 1968, when item 429.90 was replaced with two new items: item 429.85 tetramethyl lead on which the rate was not reduced, and item 429.95 on which the rate was reduced as shown above. The rate shown for item 429.95 as existing prior to January 1, 1968, is the rate for item 429.90 which remained unchanged under the TSUS from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. production, producers, exports, and imports

About 50 companies produce one or more of the compounds included in this summary. Few companies produce compounds in more than one subgroup. The value of U.S. production in 1966 is estimated to have been more than $200 million, of which two-thirds was accounted for by organometallic compounds; one-fifth, by phosgene; and the remainder, by peroxides, metallic alcoholates, natural products, and research items. Exports are included with those of numerous other articles.

U.S. imports have increased rapidly, from 1.9 million pounds, valued at $2 million, in 1964 to 5.8 million pounds, valued at $3.2 million in 1967 (see table). They have included peroxides from the Netherlands, organometallic compounds and research chemicals from Japan, eucalyptol from Spain, medicinal intermediates and research chemicals from Switzerland, and numerous unidentified and misclassified items.

The principal types of products covered in this summary are covered in detail in the following discussion.

The "organometallic" compounds, discussed here, contain a metallic or metalloid atom attached directly to a carbon atom in an organic radical. "Metallo-organic" compounds, discussed elsewhere, contain a metallic atom attached to a carbon atom through another atom, such as an oxygen in salts of organic acids and metallic alcoholates. The major organometallics are those derived from silicon, lead, aluminum, and tin, but some are obtained from arsenic, boron, cadmium, cobalt, iron, lithium, magnesium, manganese, mercury, phosphorus, titanium, and zinc.

About 20 firms produce organometallics. Several are primarily producers of the metal and its inorganic derivatives and produce related organic compounds as specialty and developmental items. Few

produce compounds from more than one metal. Production, which is growing rapidly, is valued at an estimated $125 million a year.

Silicon compounds--by far the most important organometallics--are prepared by reacting methyl chloride with powdered silicon to form chloromethylsilanes, which are further hydrolyzed and polymerized to silicone fluids and greases. Silicones are chemically inert, water repellent, and stable at high temperatures. They are used in lubricants, polishes, mold release agents, water repellents, antifoam agents, and hydraulic and other functional fluids. Silicones are produced by four U.S. firms--a petrochemical company, a producer of electrical equipment, a firm which is a joint venture between a petrochemical and a glass company, and a producer of organic and inorganic chemicals. They are imported from West Germany, but such imports have been small compared with U.S. production.

Although they are still much less important than tetraethyl lead, mixed alkyl leads (ethyl trimethyl lead, diethyl dimethyl lead, and triethyl methyl lead) are finding increasing use as antiknock additives for gasoline for compact cars and gasolines with high aromatic content. They are produced by four companies, three of which also produce tetraethyllead. No imports have been entered in recent years.

Alkyl tin compounds are used as stabilizers for polyvinly chloride resins to prevent atmospheric degradation and in pulp mills to control slime. They are produced by two U.S. firms. Imports, principally from Japan and the United Kingdom, account for a substantial part of U.S. consumption.

Other commercially important compounds include the following: aluminum alkyls (produced by two firms) and lithium alkyls (produced by one firm), both used as catalysts in the polymerization of polyolefins; mercury alkyls (produced by two companies) used as agricultural fungicides and seed disinfectants; magnesium alkyl halides or Grignard reagents (produced by one company), used as intermediates for medicinals; and methylcyclopentadienylmanganese tricarbonyl (produced by one firm), used as a gasoline additive. Numerous other organometallic compounds are sold in small volume for development of new uses. Imports of these compounds are negligible or nonexistent.

Phosgene (also known as carbonyl chloride) is a poisonous gas produced by the reaction between carbon monoxide and chlorine and used as an intermediate in the synthesis of other chemicals. About three-fourths of the phosgene produced is used to make isocyanates for the synthesis of urethane plastics. The remainder is used for the synthesis of other chemicals, including insecticides, dyes, catalysts, medicinals, and polycarbonate resins.

Phosgene is consumed almost entirely in the plants where it is produced. Domestic sales account for less than 5 percent of production, and imports and exports are negligible or nonexistent. Phosgene was produced in 1967 by 16 firms at 17 plants, three each in Louisiana and West Virginia, two each in Maryland, Ohio, and Texas, and the others in Alabama, Indiana, Michigan, New Jersey, and New York. Most of the producers make a variety of other organic chemicals, and several produce inorganic chemicals as well. As shown in the following tabulation, compiled from data published by the Tariff Commission in Synthetic Organic Chemicals, United States Production and Sales, U.S. production of phosgene increased rapidly in 1958-67:

Year	Quantity (1,000 pounds)	Value 1/ (1,000 dollars)
1958----------	9,130	1,415
1961----------	57,875	8,971
1962----------	111,999	17,360
1963----------	212,072	32,872
1964----------	244,965	37,970
1965----------	284,671	44,124
1966----------	329,751	50,111
1967----------	372,043	55,706

1/ Estimated from quoted sales price.

Peroxides are compounds which contain two oxygen atoms joined to each other. They cover less than 25 commercially important products, including diacyl peroxides, ketone peroxides, peroxy esters, alkyl peroxides, and hydroperoxides. The principal one, benzoyl peroxide, is classified elsewhere, in item 403.60. Peroxides are produced by the oxidation with oxygen or hydrogen peroxide of an alkyl sulfate, acyl halide, olefin, alcohol, or ketone. All peroxides have a high degree of reactivity. Some explode violently if jarred slightly; others can be transported safely but decompose gradually, under controlled temperature, into free radicals. When mixed with certain monomers, the free radicals act to initiate and direct the polymerization of elastomers and polyolefin, vinyl, and polyester resins.

Peroxides are produced by one or two large integrated firms and by seven or eight small producers of specialties. Total production

is valued at an estimated $10 million a year. Production in 1964-66 of the items for which statistics are reported (in the U.S. Tariff Commission publication Synthetic Organic Chemicals, United States Production and Sales) is as follows:

Item	1964		1965		1966	
	Quantity	Value 1/	Quantity	Value 1/	Quantity	Value 1/
	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
2-Butanone peroxide (Methyl ethyl ketone peroxide)	1,486	1,813	1,676	2,631	1,896	2,881
tert-Butyl hydroperoxide	130	257	145	289	176	306
tert-Butyl peroxide	1,074	1,858	1,011	1,658	1,367	1,941
Decanoyl peroxide	314	462	667	920	1,028	1,398
Lauroyl peroxide	1,427	1,727	1,333	1,386	1,891	1,853

1/ Figures computed from unit value of sales.

U.S. imports of peroxides account for less than 10 percent of consumption. They include tert-butyl peroxide from West Germany, hexanoyl peroxide from the United Kingdom, and lauroyl peroxide and 2-butanone peroxide from the Netherlands. Exports of peroxides are not shown separately in official statistics, but they are believed to be small.

Metallic alcoholates are compounds in which the hydrogen atom of a hydroxyl (or alcoholic) group has been replaced by a metal. Fewer than a dozen are of commercial importance; they include aluminum, magnesium, and sodium derivatives of alcohols of low molecular weight. Sodium methoxide (also known as sodium methylate), the most important, is used in organic synthesis--as a reducing and condensing agent, a catalyst, and an intermediate.

Sodium methoxide is produced by eight U.S. firms varying in size. Annual production ranges from 4.0 million to 6.5 million pounds, valued at $1 million to $2 million. The production of other metallic alcoholates is believed to be relatively small. Imports in recent years have consisted principally of sodium methoxide from West Germany and have accounted for a negligible share of U.S. consumption.

Natural products and research chemicals--The chief chemical included is eucalyptol, obtained from eucalyptus oil and used as an expectorant and antiseptic. It is not produced in the United States and is imported principally from Spain. Other chemicals included are largely articles for biochemical research and the development of new applications.

Organic compounds not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Japan	157	188	783	771
Netherlands	137	344	146	4,510
Switzerland	34	8	20	52
West Germany	1,190	1,127	166	227
Spain	182	166	219	144
United Kingdom	129	1,472	4,434	112
All other	29	1	117	30
Total	1,858	3,306	5,885	5,846
	Value (1,000 dollars)			
Japan	193	243	1,084	1,227
Netherlands	234	343	319	624
Switzerland	93	47	218	512
West Germany	908	725	199	198
Spain	229	194	245	137
United Kingdom	131	815	601	102
All other	184	40	107	416
Total	1,972	2,407	2,773	3,216

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Mixtures of two or more organic compounds----------	430.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertintent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Mixtures of organic compounds, not named elsewhere in the tariff, constitute a tariff concept rather than an identifiable industrial classifiaction. Imports of such articles had a value of $1.5 million in 1967.

Description and uses

The classification covered in this summary is designed to insure complete statistical coverage of organic compounds and does not describe a recognized group of commercial products. It covers those mixtures of organic compounds which are not covered elsewhere in the TSUS by more specific provisions based on use, composition, or origin, and includes both mixtures of isomers and coproducts obtained coincidentally by the manufacturing process and mixtures of separately produced compounds prepared for a variety of special purposes.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item		Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
430.00	Mixtures of two or more organic compounds.	10.5% ad val., but not less than the highest rate applicable to any component compounds.	5% ad val., but not less than the highest rate applicable to any component compounds.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative

January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

In determining the highest rate of duty applicable to a mixture of compounds which are dutiable at rates that are dissimilar in type, such as ad valorem, specific, and compound, the highest rate is determined by converting all of the rates to ad valorem equivalents; however, if on this basis it is determined that the highest rate is either compound or specific, the specific or the compound rate or the ad valorem equivalent of either is applied, according to the rate which will net the greatest amount of duty on the shipment.

U.S. production, exports, and imports

No meaningful estimate of U.S. production can be made. Mixtures of organic compounds are made in the normal course of production by virtually every firm that synthesizes organic chemicals, but such mixtures are generally separated into individual components before sale. Many additional mixtures, however, are prepared for special purposes by chemical producers as well as by firms that are not primarily chemical producers.

U.S. imports of mixtures increased from 0.5 million pounds, valued at $230.000, in 1964 to 14.4 million pounds, valued at $1.5 million, in 1967 (see table). Canada and West Germany were the principal sources. Imports have included mixtures of chemically defined coproducts and various mixtures and preparations for which chemical descriptions were not available.

In the long run, the tariff provision for the highest rate applicable to any component compound tends to restrain imports of mixtures containing small portions of chemicals dutiable at rates having high ad valorem equivalents. If the rate differential among components of a mixture is great, and the volume of imports sufficiently large, the importer can generally choose to import the components separately.

U.S. exports are not separately classified in official statistics, but they are probably substantially larger than imports.

Mixtures of two or more organic compounds: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
Canada	5	1,654	5,511	10,244
West Germany	382	348	211	727
Sweden	-	6	80	3
Trinidad	-	-	1,279	2,376
France	5	7	4	869
All other	129	329	480	175
Total	521	2,344	7,565	14,394
	Value (1,000 dollars)			
Canada	6	103	323	705
West Germany	140	100	97	435
Sweden	-	32	86	145
Trinidad	-	-	59	119
France	7	10	1/	58
All other	77	167	104	41
Total	230	412	669	1,503

1/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Chemical mixtures not specially provided for	432.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1969) (pertinent sections thereof are reproduced in appendix A to this volume).

U.S. trade position

Mixtures of inorganic and organic compounds, not named elsewhere in the tariff, constitute a tariff concept rather than an identifiable industrial classification. Imports of such articles has a value of $1.5 million in 1967.

Description and uses

TSUS item 432.00 covers chemical mixtures not covered by items 423.80 to 423.96 (mixtures of inorganic compounds) and 430.00 (mixtures of organic compounds). Also excluded are any mixtures that have a specified end use, e.g., drugs and fertilizers. Accordingly the mixtures under consideration consist of one or more inorganic compounds and one or more organic compounds. The number of chemical mixtures covered by this definition is estimated to be very large, possibly amounting to a thousand or more. From current information it appears that most of the products actually traded are nonmedicinal proprietary mixtures, including mixtures made to customer specifications for industrial uses.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1969) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
432.00	Chemical mixtures not specially provided for.	10.5% ad val., but not less than the highest rate applicable to any component material.	5% ad val., but not less than the highest rate applicable to any component material.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1969, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, had remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Production and trade

A large number of concerns (small, medium, and large) produce one or more of the chemical mixtures covered here. There is no basis for estimating annual domestic production, which may reach high figures on both a quantity and a value basis.

Export data comparable with available import data are not published in official statistics. There is not basis for estimating domestic exports, though they are probably quite substantial. Imports have been reported in this classification only since August 31, 1963. In 1967 they amounted to 4.4 million pounds, valued at $1.5 million. West Germany, Switzerland, and Canada, the United Kingdom, and the Netherlands, were the leading suppliers (see accompanying table). To a considerable extent, imports of these chemical mixtures supplement rather than compete with domestic products, and as domestic requirements increase, so do imports.

Foreign production of such chemical mixtures exists in countries with well-developed chemical industries. It is estimated that both local consumption and exports are substantial for the countries that were sources of U.S. imports in 1964-67.

Chemical mixtures not specially provided for: U.S. imports for consumption, by principal sources, 1964-67

Source	1964	1965	1966	1967
	Quantity (1,000 pounds)			
West Germany	351	450	894	859
Switzerland	5	27	2	115
Canada	250	167	265	843
United Kingdom	90	385	705	873
Netherlands	93	241	561	533
France	35	221	265	399
Belgium	2	145	208	126
Japan	91	838	204	17
All other	218	348	294	632
Total	1,135	2,822	3,398	4,397
	Value (1,000 dollars)			
West Germany	195	343	609	614
Switzerland	15	32	14	205
Canada	74	33	53	188
United Kingdom	105	109	208	153
Netherlands	25	73	144	129
France	24	40	52	74
Belgium	2	23	91	31
Japan	23	184	42	13
All other	59	63	63	120
Total	522	900	1,276	1,527

Source: Compiled from official statistics of the U.S. Department of Commerce.

A P P E N D I X A

Tariff Schedules of the United States Annotated (1969): General headnotes and rules of interpretation, and excerpts relating to the items included in this volume.

NOTE: The shaded areas in this appendix cover headnotes and TSUS items not pertaining to summaries in this volume.

1. Tariff Treatment of Imported Articles. All articles imported into the customs territory of the United States from outside thereof are subject to duty or exempt therefrom as prescribed in general headnote 3.

2. Customs Territory of the United States. The term "customs territory of the United States", as used in the schedules, includes only the States, the District of Columbia, and Puerto Rico.

3. Rates of Duty. The rates of duty in the "Rates of Duty" columns numbered 1 and 2 of the schedules apply to articles imported into the customs territory of the United States as hereinafter provided in this headnote:

(a) Products of Insular Possessions.

(i) Except as provided in headnote 6 of schedule 7, part 2, subpart E, [and] except as provided in headnote 4 of schedule 7, part 7, subpart A, articles imported from insular possessions of the United States which are outside the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules, except that all such articles the growth or product of any such possession, or manufactured or produced in any such possession from materials the growth, product, or manufacture of any such possession or of the customs territory of the United States, or of both, which do not contain foreign materials to the value of more than 50 percent of their total value, coming to the customs territory of the United States directly from any such possession, and all articles previously imported into the customs territory of the United States with payment of all applicable duties and taxes imposed upon or by reason of importation which were shipped from the United States, without remission, refund, or drawback of such duties or taxes, directly to the possession from which they are being returned by direct shipment, are exempt from duty.

(ii) In determining whether an article produced or manufactured in any such insular possession contains foreign materials to the value of more than 50 percent, no material shall be considered foreign which, at the time such article is entered, may be imported into the customs territory from a foreign country, other than Cuba or the Philippine Republic, and entered free of duty.

(b) Products of Cuba. Products of Cuba imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. Preferential rates of duty for such products apply only as shown in the said column 1. 1/

(c) Products of the Philippine Republic.

(i) Products of the Philippine Republic imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty which are set forth in column numbered 1 of the schedules or to fractional parts of the rates in the said column 1, as hereinafter prescribed in subdivisions (c)(ii) and (c)(iii) of this headnote.

(ii) Except as otherwise prescribed in the schedules, a Philippine article, as defined in subdivision (c)(iv) of this headnote, imported into the customs territory of the United States and entered on or before July 3, 1974, is subject to that rate which results from the application of the following percentages to the most favorable rate of duty (i.e., including a preferential rate prescribed for any product of Cuba) set forth in column numbered 1 of the schedules:

(A) 20 percent, during calendar years 1963 through 1964,

(B) 40 percent, during calendar years 1965 through 1967,

(C) 60 percent, during calendar years 1968 through 1970,

(D) 80 percent, during calendar years 1971 through 1973,

(E) 100 percent, during the period from January 1, 1974, through July 3, 1974.

(iii) Except as otherwise prescribed in the schedules, products of the Philippine Republic, other than Philippine articles, are subject to the rates of duty (except any preferential rates prescribed for products of Cuba) set forth in column numbered 1 of the schedules.

(iv) The term "Philippine article", as used in the schedules, means an article which is the product of the Philippines, but does not include any article produced with the use of materials imported into the Philippines which are products of any foreign country (except materials produced within the customs territory of the United States) if the aggregate value of such imported materials when landed at the Philippine port of entry, exclusive of any landing cost and Philippine duty, was more than 20 percent of the appraised customs value of the article imported into the customs territory of the United States.

(d) Products of Canada.

(i) Products of Canada imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. The rates of duty for a Canadian article, as defined in subdivision (d)(ii) of this headnote, apply only as shown in the said column numbered 1.

(ii) The term "Canadian article", as used in the schedules, means an article which is the product of Canada, but does not include any article produced with the use of materials imported into Canada which are products of any foreign country (except materials produced within the customs territory of the United States), if the aggregate value of such imported materials when landed at the Canadian port of entry (that is, the actual purchase price, or if not purchased, the export value, of such materials, plus, if not included therein, the cost of transporting such materials to Canada but exclusive of any landing cost and Canadian duty) was --

(A) with regard to any motor vehicle or automobile truck tractor entered on or before December 31, 1967, more than 60 percent of the appraised value of the article imported into the customs territory of the United States: and

(B) with regard to any other article (including any motor vehicle or automobile truck tractor entered after December 31, 1967), more than 50 percent of the appraised value of the article imported into the customs territory of the United States.

(e) Products of Communist Countries. Notwithstanding any of the foregoing provisions of this headnote, the rates of duty shown in column numbered 2 shall apply to products, whether imported directly or indirectly, of the following countries and areas pursuant to section 401 of the Tariff Classification Act of 1962, to section 231 or 257(e) (2) of the Trade Expansion Act of 1962, or to

1/ By virtue of section 401 of the Tariff Classification Act of 1962, the application to products of Cuba of either a preferential or other reduced rate of duty in column 1 is suspended. See general headnote 3(e), infra. The provisions for preferential Cuban rates continue to be reflected in the schedules because, under section 401, the rates therefor in column 1 still form the bases for determining the rates of duty applicable to certain products, including "Philippine articles".

APPENDIX A
TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

General Headnotes and Rules of Interpretation

action taken by the President thereunder:
Albania
Bulgaria
China (any part of which may be under Communist domination or control)
Cuba 1/
Czechoslovakia
Estonia
Germany (the Soviet zone and the Soviet sector of Berlin)
Hungary
Indochina (any part of Cambodia, Laos, or Vietnam which may be under Communist domination or control)
Korea (any part of which may be under Communist domination or control)
Kurile Islands
Latvia
Lithuania
Outer Mongolia
Rumania
Southern Sakhalin
Tanna Tuva
Tibet
Union of Soviet Socialist Republics and the area in East Prussia under the provisional administration of the Union of Soviet Socialist Republics.

(f) Products of All Other Countries. Products of all countries not previously mentioned in this headnote imported into the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules.

(g) Effective Date; Exceptions - Staged Rates of Duty. 2/ Except as specified below or as may be specified elsewhere, pursuant to section 501(a) of the Tariff Classification Act of 1962 (P.L. 87-456, approved May 24, 1962), the rates of duty in columns numbered 1 and 2 become effective with respect to articles entered on or after the 10th day following the date of the President's proclamation provided for in section 102 of the said Act. If, in column numbered 1, any rate of duty or part thereof is set forth in parenthesis, the effective date shall be governed as follows:

(i) If the rate in column numbered 1 has only one part (i.e., 8¢ (10¢) per lb.), the parenthetical rate (viz., 10¢ per lb.) shall be effective as to articles entered before July 1, 1964, and the other rate (viz., 8¢ per lb.) shall be effective as to articles entered on or after July 1, 1964.

(ii) If the rate in column numbered 1 has two or more parts (i.e., 5¢ per lb. + 50% ad val.) and has a parenthetical rate for either or both parts, each part of the rate shall be governed as if it were a one-part rate. For example, if a rate is expressed as "4¢ (4.5¢) per lb. + 8% (9%) ad val.", the rate applicable to articles entered before July 1, 1964, would be "4.5¢ per lb. + 9% ad val."; the rate applicable to articles entered on or after July 1, 1964, would be "4¢ per lb. + 8% ad val.".

(iii) If the rate in column numbered 1 is marked with an asterisk (*), the foregoing provisions of (i) and (ii) shall apply except that "January 1, 1964" shall be substituted for "July 1, 1964", wherever this latter date appears.

1/ In Proclamation 3447, dated February 3, 1962, the President, acting under authority of section 620(a) of the Foreign Assistance Act of 1961 (75 Stat. 445), as amended, prohibited the importation into the United States of all goods of Cuban origin and all goods imported from or through Cuba, subject to such exceptions as the Secretary of the Treasury determines to be consistent with the effective operation of the embargo.

2/ The purpose of headnote 3(g) was to provide for an effective date for the rates of duty initially contained in the Tariff Schedules of the United States. By Presidential Proclamation 3548 of August 21, 1963, these rates of duty, except as noted in subparagraphs (i), (ii), and (iii) of headnote 3(g), became effective on August 31, 1963.

4. Modification or Amendment of Rates of Duty. Except as otherwise provided in the Appendix to the Tariff Schedules --

(a) a statutory rate of duty supersedes and terminates the existing rates of duty in both column numbered 1 and column numbered 2 unless otherwise specified in the amending statute;

(b) a rate of duty proclaimed pursuant to a concession granted in a trade agreement shall be reflected in column numbered 1 and, if higher than the then existing rate in column numbered 2, also in the latter column, and shall supersede but not terminate the then existing rate (or rates) in such column (or columns);

(c) a rate of duty proclaimed pursuant to section 336 of the Tariff Act of 1930 shall be reflected in both column numbered 1 and column numbered 2 and shall supersede but not terminate the then existing rates in such columns; and

(d) whenever a proclaimed rate is terminated or suspended, the rate shall revert, unless otherwise provided, to the next intervening proclaimed rate previously superseded but not terminated or, if none, to the statutory rate.

5. Intangibles. For the purposes of headnote 1 --
(a) corpses, together with their coffins and accompanying flowers,
(b) currency (metal or paper) in current circulation in any country and imported for monetary purposes,
(c) electricity,
(d) securities and similar evidences of value, and
(e) vessels which are not "yachts or pleasure boats" within the purview of subpart D, part 6, of schedule 6,
are not articles subject to the provisions of these schedules.

6. Containers or Holders for Imported Merchandise. For the purposes of the tariff schedules, containers or holders are subject to tariff treatment as follows:

(a) Imported Empty: Containers or holders if imported empty are subject to tariff treatment as imported articles and as such are subject to duty unless they are within the purview of a provision which specifically exempts them from duty.

(b) Not Imported Empty: Containers or holders if imported containing or holding articles are subject to tariff treatment as follows:

(i) The usual or ordinary types of shipping or transportation containers or holders, if not designed for, or capable of, reuse, and containers of usual types ordinarily sold at retail with their contents, are not subject to treatment as imported articles. Their cost, however, is, under section 402 or section 402a of the tariff act, a part of the value of their contents and if their contents are subject to an ad valorem rate of duty such containers or holders are, in effect, dutiable at the same rate as their contents, except that their cost is deductible from dutiable value upon submission of satisfactory proof that they are products of the United States which are being returned without having been advanced in value or improved in condition by any means while abroad.

(ii) The usual or ordinary types of shipping or transportation containers or holders, if designed for, or capable of, reuse, are subject to treatment as imported articles separate and distinct from their contents. Such holders or containers are not part of the dutiable value of their contents and are separately subject to duty upon each and every importation into the customs territory of the United States unless within the scope of a provision specifically exempting them from duty.

(iii) In the absence of context which requires otherwise, all other containers or holders are subject to the same treatment as specified in (ii) above for usual or ordinary types of shipping or transportation containers or holders designed for, or capable of, reuse.

7. Commingling of Articles. (a) Whenever articles subject to different rates of duty are so packed together or mingled that the quantity or value of each class of articles cannot be readily ascertained by customs officers (without physical segregation of the shipment or the contents of any entire package thereof), by one or more of the following means:

(i) sampling,

(ii) verification of packing lists or other documents filed at the time of entry, or

(iii) evidence showing performance of commercial settlement tests generally accepted in the trade and filed in such time and manner as may be prescribed by regulations of the Secretary of the Treasury,

the commingled articles shall be subject to the highest rate of duty applicable to any part thereof unless the consignee or his agent segregates the articles pursuant to subdivision (b) hereof.

(b) Every segregation of articles made pursuant to this headnote shall be accomplished by the consignee or his agent at the risk and expense of the consignee within 30 days (unless the Secretary authorizes in writing a longer time) after the date of personal delivery or mailing, by such employee as the Secretary of the Treasury shall designate, of written notice to the consignee that the articles are commingled and that the quantity or value of each class of articles cannot be readily ascertained by customs officers. Every such segregation shall be accomplished under customs supervision, and the compensation and expenses of the supervising customs officers shall be reimbursed to the Government by the consignee under such regulations as the Secretary of the Treasury may prescribe.

(c) The foregoing provisions of this headnote do not apply with respect to any part of a shipment if the consignee or his agent furnishes, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that such part (A) is commercially negligible, (B) is not capable of segregation without excessive cost, and (C) will not be segregated prior to its use in a manufacturing process or otherwise, and

(ii) that the commingling was not intended to avoid the payment of lawful duties.

Any article with respect to which such proof is furnished shall be considered for all customs purposes as a part of the article, subject to the next lower rate of duty, with which it is commingled.

(d) The foregoing provisions of this headnote do not apply with respect to any shipment if the consignee or his agent shall furnish, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that the value of the commingled articles is less than the aggregate value would be if the shipment were segregated;

(ii) that the shipment is not capable of segregation without excessive cost and will not be segregated prior to its use in a manufacturing process or otherwise; and

(iii) that the commingling was not intended to avoid the payment of lawful duties.

Any merchandise with respect to which such proof is furnished shall be considered for all customs purposes to be dutiable at the rate applicable to the material present in greater quantity than any other material.

(e) The provisions of this headnote shall apply only in cases where the schedules do not expressly provide a particular tariff treatment for commingled articles.

8. Abbreviations. In the schedules the following symbols and abbreviations are used with the meanings respectively indicated below:

$	-	dollars
¢	-	cents
%	-	percent
+	-	plus
ad val.	-	ad valorem
bu.	-	bushel
cu.	-	cubic
doz.	-	dozen
ft.	-	feet
gal.	-	gallon
in.	-	inches
lb.	-	pounds
oz.	-	ounces
sq.	-	square
wt.	-	weight
yd.	-	yard
pcs.	-	pieces
prs.	-	pairs
lin.	-	linear
I.R.C.	-	Internal Revenue Code

9. Definitions. For the purposes of the schedules, unless the context otherwise requires --

(a) the term "entered" means entered, or withdrawn from warehouse, for consumption in the customs territory of the United States;

(b) the term "entered for consumption" does not include withdrawals from warehouse for consumption;

(c) the term "withdrawn for consumption" means withdrawn from warehouse for consumption and does not include articles entered for consumption;

(d) the term "rate of duty" includes a free rate of duty; rates of duty proclaimed by the President shall be referred to as "proclaimed" rates of duty; rates of duty enacted by the Congress shall be referred to as "statutory" rates of duty; and the rates of duty in column numbered 2 at the time the schedules become effective shall be referred to as "original statutory" rates of duty;

(e) the term "ton" means 2,240 pounds, and the term "short ton" means 2,000 pounds;

(f) the terms "of", "wholly of", "almost wholly of", "in part of" and "containing", when used between the description of an article and a material (e.g., "furniture of wood", "woven fabrics, wholly of cotton", etc.), have the following meanings:

(i) "of" means that the article is wholly or in chief value of the named material;

(ii) "wholly of" means that the article is, except for negligible or insignificant quantities of some other material or materials, composed completely of the named material;

(iii) "almost wholly of" means that the essential character of the article is imparted by the named material, notwithstanding the fact that significant quantities of some other material or materials may be present; and

(iv) "in part of" or "containing" mean that the article contains a significant quantity of the named material.

With regard to the application of the quantitative concepts specified in subparagraphs (ii) and (iv) above, it is intended that the de minimis rule apply.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

General Headnotes and Rules of Interpretation

10. General Interpretative Rules. For the purposes of these schedules --

(a) the general, schedule, part, and subpart headnotes, and the provisions describing the classes of imported articles and specifying the rates of duty or other import restrictions to be imposed thereon are subject to the rules of interpretation set forth herein and to such other rules of statutory interpretation, not inconsistent therewith, as have been or may be developed under administrative or judicial rulings;

(b) the titles of the various schedules, parts, and subparts and the footnotes therein are intended for convenience in reference only and have no legal or interpretative significance;

(c) an imported article which is described in two or more provisions of the schedules is classifiable in the provision which most specifically describes it; but, in applying this rule of interpretation, the following considerations shall govern:

(i) a superior heading cannot be enlarged by inferior headings indented under it but can be limited thereby;

(ii) comparisons are to be made only between provisions of coordinate or equal status, i.e., between the primary or main superior headings of the schedules or between coordinate inferior headings which are subordinate to the same superior heading;

(d) if two or more tariff descriptions are equally applicable to an article, such article shall be subject to duty under the description for which the original statutory rate is highest, and, should the highest original statutory rate be applicable to two or more of such descriptions, the article shall be subject to duty under that one of such descriptions which first appears in the schedules;

(e) in the absence of special language or context which otherwise requires --

(i) a tariff classification controlled by use (other than actual use) is to be determined in accordance with the use in the United States at, or immediately prior to, the date of importation, of articles of that class or kind to which the imported articles belong, and the controlling use is the chief use, i.e., the use which exceeds all other uses (if any) combined;

(ii) a tariff classification controlled by the actual use to which an imported article is put in the United States is satisfied only if such use is intended at the time of importation, the article is so used, and proof thereof is furnished within 3 years after the date the article is entered;

(f) an article is in chief value of a material if such material exceeds in value each other single component material of the article;

(g) a headnote provision which enumerates articles not included in a schedule, part, or subpart is not necessarily exhaustive, and the absence of a particular article from such headnote provision shall not be given weight in determining the relative specificity of competing provisions which describe such article;

(h) unless the context requires otherwise, a tariff description for an article covers such article, whether assembled or not assembled, and whether finished or not finished;

(ij) a provision for "parts" of an article covers a product solely or chiefly used as a part of such article, but does not prevail over a specific provision for such part.

11. Issuance of Rules and Regulations. The Secretary of the Treasury is hereby authorized to issue rules and regulations governing the admission of articles under the provisions of the schedules. The allowance of an importer's claim for classification, under any of the provisions of the schedules which provide for total or partial relief from duty or other import restrictions on the basis of facts which are not determinable from an examination of the article itself in its condition as imported, is dependent upon his complying with any rules or regulations which may be issued pursuant to this headnote.

12. The Secretary of the Treasury is authorized to prescribe methods of analyzing, testing, sampling, weighing, gauging, measuring, or other methods of ascertainment whenever he finds that such methods are necessary to determine the physical, chemical, or other properties or characteristics of articles for purposes of any law administered by the Customs Service.

General statistical headnotes:

1. Statistical Requirements for Imported Articles. Persons making customs entry or withdrawal of articles imported into the customs territory of the United States shall complete the entry or withdrawal forms, as provided herein and in regulations issued pursuant to law, to provide for statistical purposes information as follows:

(a) the number of the Customs district and of the port where the articles are being entered for consumption or warehouse, as shown in Statistical Annex A of these schedules;

(b) the name of the carrier or the means of transportation by which the articles were transported to the first port of unloading in the United States;

(c) the foreign port of lading;

(d) the United States port of unlading;

(e) the date of importation;

(f) the country of origin of the articles expressed in terms of the designation therefor in Statistical Annex B of these schedules;

(g) a description of the articles in sufficient detail to permit the classification thereof under the proper statistical reporting number in these schedules;

(h) the statistical reporting number under which the articles are classifiable;

(ij) gross weight in pounds for the articles covered by each reporting number when imported in vessels or aircraft;

(k) the net quantity in the units specified herein for the classification involved;

(l) the U.S. dollar value in accordance with the definition in Section 402 or 402a of the Tariff Act of 1930, as amended, for all merchandise including that free of duty or dutiable at specific rates; and

(m) such other information with respect to the imported articles as is provided for elsewhere in these schedules.

2. Statistical Annotations. (a) The statistical annotations to the Tariff Schedules of the United States consist of --

(i) the 2-digit statistical suffixes,
(ii) the indicated units of quantity,
(iii) the statistical headnotes and annexes, and
(iv) the italicized article descriptions.

(b) The legal text of the Tariff Schedules of the United States consists of the remaining text as more specifically identified in headnote 10(a) of the general headnotes and rules of interpretation.

(c) The statistical annotations are subordinate to the provisions of the legal text and cannot change their scope.

3. Statistical Reporting Number. (a) General Rule: Except as provided in paragraph (b) of this headnote, and in the absence of specific instructions to the contrary elsewhere, the statistical reporting number for an article consists of the 7-digit number formed by combining the 5-digit item number with the appropriate 2-digit statistical suffix. Thus, the statistical reporting number for live monkeys dutiable under item 100.95 is "100.9520".

(b) Wherever in the tariff schedules an article is classifiable under a provision which derives its rate of duty from a different provision, the statistical reporting number is, in the absence of specific instructions to the contrary elsewhere, the 7-digit number for the basic provision followed by the item number of the provision from which the rate is derived. Thus, the statistical reporting number of mixed apple and grape juices, not containing over 1.0 percent of ethyl alcohol by volume, is "165.6500-165.40".

4. Abbreviations. (a) The following symbols and abbreviations are used with the meanings respectively indicated below:

s. ton	-	short ton
C.	-	one hundred
Cwt.	-	100 lbs.
mg.	-	milligram
M.	-	1,000
bd. ft.	-	board feet
M. bd. ft.	-	1,000 board feet
mc.	-	millicurie
cord	-	128 cubic feet
square	-	amount to cover 100 square feet of surface
sup. ft.	-	superficial foot
oz.	-	ounces avoirdupois
fl. oz.	-	fluid ounce
oz. troy	-	troy ounce
pf. gal.	-	proof gallon

(b) An "X" appearing in the column for units of quantity means that no quantity (other than gross weight) is to be reported.

(c) Whenever two separate units of quantity are shown for the same article, the "v" following one of such units means that the value of the article is to be reported with that quantity.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

HISTORICAL NOTES

Amendments and Modifications

PROVISIONS	
Gen Hdnte 3(a)(i)	Language "Except as provided in headnote 6 of schedule 7, part 2, subpart E," added; language "except that all articles" deleted and language "except that all such articles" inserted in lieu thereof. Pub. L. 89-805, Secs. 1(a), (c), Nov. 10, 1966, 80 Stat. 1521, 1522, effective date Jan. 1, 1967.
	Language "Except as provided in headnote 4 of schedule 7, part 7, subpart A," added. Pub. L. 89-806, Secs. 2(b), (c), Nov. 10, 1966, 80 Stat. 1523, effective date March 11, 1967.

PROVISIONS	
Gen Hdnte 3(d), (e), (f) and (g)	Headnotes 3(d), (e), and (f) redesignated as headnotes 3(e), (f), and (g), respectively, and new headnote 3(d) added. Pub. L. 89-283, Secs. 401(a), 403, Oct. 21, 1965, 79 Stat. 1021, 1022; entered into force Oct. 22, 1965, by Pres. Proc. 3682, Oct. 21, 1965, 3 CFR, 1965 Supp., p. 68.
Gen Hdnte 6(b)(i)	Language "and containers of usual types ordinarily sold at retail with their contents," added. Pub. L. 89-241, Secs. 2(a), 4, Oct. 7, 1965, 79 Stat. 933, 934, effective date Dec. 7, 1965.

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

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Part 1 - Benzenoid Chemicals and Products
A. Organic Chemical Crudes
B. Industrial Organic Chemicals
C. Finished Organic Chemical Products

Part 2 - Chemical Elements, Inorganic and Organic Compounds, and Mixtures
A. Chemical Elements
B. Inorganic Acids
C. Inorganic Chemical Compounds
D. Organic Chemical Compounds
E. Chemical Mixtures

Part 3 - Drugs and Related Products
A. Natural Drugs, Crude or Advanced
B. Alkaloids, Antibiotics, Barbiturates, Hormones, Vitamins, and Other Drugs and Related Products
C. Other Drugs

Part 4 - Synthetic Resins and Plastics Materials; Rubber
A. Synthetic Resins and Plastics Materials
B. Rubber

Part 5 - Flavoring Extracts; Essential Oils
A. Flavoring Extracts, and Fruit Flavors, Essences, Esters, and Oils
B. Essential Oils

Part 6 - Glue, Gelatin, and Related Products

Part 7 - Aromatic or Odoriferous Substances; Perfumery, Cosmetics, and Toilet Preparations
A. Aromatic or Odoriferous Substances
B. Perfumery, Cosmetics, and Toilet Preparations

Part 8 - Surface-Active Agents; Soap and Synthetic Detergents
A. Surface-Active Agents
B. Soap and Synthetic Detergents

Part 9 - Dyeing and Tanning Products; Pigments and Pigment-Like Materials; Inks, Paints, and Related Products
A. Dyeing and Tanning Products
B. Pigments and Pigment-like Materials
C. Inks, Paints, and Related Products

Part 10 - Petroleum, Natural Gas, and Products Derived Therefrom

Part 11 - Fertilizers and Fertilizer Materials

Part 12 - Explosives

Part 13 - Fatty Substances, Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products
A. Fatty Substances
B. Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products
C. Miscellaneous Medical Supplies

Schedule 4 headnotes:

1. This schedule does not include --
   (i) any of the mineral products provided for in schedule 5;
   (ii) metal-bearing ores and other metal-bearing materials, provided for in part 1 of schedule 6; or
   (iii) metals provided for in part 2 of schedule 6.

2. (a) The term "compounds", as used in this schedule, means substances occurring naturally or produced artificially by the reaction of two or more ingredients, each compound --
   (i) consisting of two or more elements,
   (ii) having its own characteristic properties different from those of its elements and from those of other compounds, and
   (iii) always consisting of the same elements united in the same proportions by weight with the same internal arrangement.

The presence of impurities which occur naturally or as an incident to production does not in itself affect the classification of a product as a compound.

(b) The term "compounds", as used in this schedule, includes a solution of a single compound in water, and, in determining the amount of duty on any such compound subject to duty in this schedule at a specific rate, an allowance in weight or volume, as the case may be, shall be made for the water in excess of any water of crystallization which may have been in the compound.

3. (a) The term "mixtures", as used in this schedule, means substances consisting of two or more ingredients (i.e., elements or compounds), whether occurring as such in nature, or whether artificially produced (i.e., brought about by mechanical, physical, or chemical means), which do not bear a fixed ratio to one another and which, however thoroughly commingled, retain their individual chemical properties and are not chemically united. The fact that the ingredients of a product are incapable of separation or have been commingled in definite proportions does not in itself affect the classification of such product as a mixture.

(b) The term "mixtures", as used in this schedule, includes solutions, except solutions defined as compounds in headnote 2(b) of this schedule.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

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SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

4 - 2 - A, B
415.05 - 416.45

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		PART 2. - CHEMICAL ELEMENTS, INORGANIC AND ORGANIC COMPOUNDS, AND MIXTURES			
		Part 2 headnotes:			
		1. This part covers chemicals, except those provided for elsewhere in this schedule and those specially provided for in any of the other schedules.			
		2. For the purpose of this part, inorganic compounds (including salts) are compounds not containing carbon, except carbides and such carbon-containing compounds as inorganic cyanides and cyanates, metallic carbonates, and oxides of carbon which are inorganic in nature.			
		3. For the purpose of this part, organic compounds are compounds containing carbon except such carbon-containing compounds as carbides, inorganic cyanides and cyanates, metallic carbonates, and oxides of carbon.			
		Subpart A. - Chemical Elements			
		Chemical elements in any physical form:			
415.05	00	Bromine	lb.	8¢ per lb.	10¢ per lb.
415.10	00	Cesium, potassium, and sodium	lb.	13.5% ad val.	25% ad val.
415.15	00	Carbon	lb.	5% ad val.	20% ad val.
415.20	00	Chlorine	lb.	8% ad val.	15% ad val.
		Iodine:			
415.25	00	Crude	lb.	Free	Free
415.27	00	Resublimed	lb.	8¢ per lb.	10¢ per lb.
415.30	00	Lithium	lb.	20% ad val.	25% ad val.
415.35	00	Phosphorus	lb.	3¢ per lb.	8¢ per lb.
415.40	00	Rubidium	lb.	8% ad val.	25% ad val.
415.43	00	Sulfur	Ton	Free	Free
415.50	00	Other	lb.	8% ad val.	25% ad val.
		Subpart B. - Inorganic Acids			
		Subpart B headnotes:			
		1. This subpart covers monobasic, dibasic, and polybasic inorganic acids. Salts and anhydrides of these acids are provided for in subpart C of this part.			
		Inorganic acids:			
416.05	00	Arsenic	lb.	2.4¢ per lb.	3¢ per lb.
416.10	00	Boric	lb.	0.4¢ per lb.	1¢ per lb.
416.15	00	Hydrochloric	lb.	Free	Free
416.20	00	Hydrofluoric	lb.	Free	Free
416.25	00	Nitric	lb.	Free	Free
416.30	00	Phosphoric	lb.	0.8¢ per lb.	2¢ per lb.
416.35	00	Sulfuric	lb.	Free	Free
416.40	00	Tungstic	lb.	33¢ per lb. on tungsten content + 16% ad val.	60¢ per lb. on tungsten content + 40% ad val.
		Tungsten contents	lb.		
416.45		Other		10% ad val.	25% ad val.
	20	Sulfonic acids	lb.		
	40	Other	lb.		

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Subpart D. - Organic Chemical Compounds			
		Subpart D headnote:			
		1. This subpart does not include any inorganic compounds. Organic compounds in this subpart are arranged according to functional group. Any organic compound which is described in more than one functional group is classifiable in the first group in which it is described.			
		Nitrogenous compounds:			
425.00	00	Acrylonitrile	lb.	2¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
425.02	00	Aldehyde ammonia	lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
425.04		Amino acids		10% ad val.	25% ad val.
	20	Methionine	lb.		
	40	Other	lb.		
425.06	00	Amine acid salts	lb.	8% ad val.	25% ad val.
425.08	00	3-Amino-1,2,4-triazole	lb.	8% ad val.	25% ad val.
425.09	00	Ammonium alginate	lb.	6.5% ad val.	25% ad val.
425.10		Cyanuric chloride, melamine, and other compounds containing a triazine ring		8% ad val.	25% ad val.
	20	Melamine	lb.		
	40	Other	lb.		
425.12	00	Diethanolamine, monoethanolamine, and triethanolamine	lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
425.14	00	Ethylenediamine	lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
425.18	00	Hexamethylenetetramine	lb.	3.6¢ per lb.	11¢ per lb.
425.20	00	Mono-, di-, and tri-(methyl-, ethyl-, propyl-, and butyl)monoamines	lb.	8% ad val.	25% ad val.
425.22	00	Ethylureas, methylolureas, octamethylpyrophosphoramide and other acyclic amides	lb.	8% ad val.	25% ad val.
425.24	00	Imides	lb.	8% ad val.	25% ad val.
425.25	00	Methyl ethyl ketoxime	lb.	8% ad val.	25% ad val.
425.28	00	N-Methyl-2-pyrrolidone	lb.	10% ad val.	25% ad val.
425.30	00	Monosodium glutamate	lb.	10% ad val.	25% ad val.
425.32	00	Nitroparaffins	lb.	8% ad val.	25% ad val.
425.34	00	2-Pyrrolidone	lb.	10% ad val.	25% ad val.
425.36	00	Thiourea, thiourea dioxide, and other thioamides; thiocarbamates, thiocyanates, thiurams, and isothiocyanates	lb.	8% ad val.	25% ad val.
425.38	00	N-Vinyl-2-pyrrolidone, monomer and polymer	lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Dicyandiamide, guanidine salts and other acyclic amidines:			
425.40	00	Dicyandiamide	lb.	Free	25% ad val.
425.41	00	Other	lb.	8% ad val.	25% ad val.
		Other:			
425.42	00	Nitriles	lb.	8% ad val.	25% ad val.
425.52	00	Other	lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Acids:			
425.70	00	Acetic	lb.	0.4¢ per lb.	2¢ per lb.
425.72	00	Chloroacetic	lb.	1¢ per lb.	6¢ per lb.
425.74	00	Citric	lb.	4.5¢ per lb.	17½ per lb.
425.75	00	Formic	lb.	1.8¢ per lb.	3¢ per lb.
425.78	00	Gallic	lb.	4.5¢ per lb.	6¢ per lb.
425.82	00	Lactic acid	lb.	12.5% ad val.	35% ad val.
425.84	00	Naphthenic	lb.	5% ad val.	25% ad val.
425.86	00	Oxalic	lb.	2¢ per lb.	6¢ per lb.
425.88	00	Pyrogallic	lb.	8¢ per lb.	12¢ per lb.
425.94	00	Tartaric	lb.	4.8¢ per lb.	8¢ per lb.
425.96	00	Valeric	lb.	Free	Free
425.98	00	Other 1/	lb.	10% ad val.	25% ad val.
		Acid anhydrides:			
426.00	00	Acetic	lb.	1.4¢ per lb.	3.5¢ per lb.
426.02	00	Valeric	lb.	Free	Free
426.04	00	Other	lb.	10% ad val.	25% ad val.

1/ Heptanoic acid is temporarily free of duty by legislation. See Appendix to Tariff Schedules.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty	
				1	2
427.30	00	Acyl halides	lb	8% ad val.	25% ad val.
		Aldehydes:			
427.40	00	Acetaldehyde	lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.42	00	Aldol or acetaldol	lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.44	00	Butyraldehyde	lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.45	00	Chloracetaldehyde	lb	8% ad val.	25% ad val.
427.46	00	Crotonaldehyde	lb	7.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.48	00	Formaldehyde (including solutions)	lb	0.7¢ per lb.	1.75¢ per lb.
427.52	00	Furfural	lb	Free	Free
427.53	00	Glyoxal	lb	8% ad val.	25% ad val.
427.54	00	Paracetaldehyde	lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.56	00	Paraformaldehyde	lb	3.2¢ per lb.	8¢ per lb.
427.58	00	Other	lb	2.4¢ per lb. + 12% ad val	6¢ per lb. + 30% ad val.
		Ketones:			
427.60	00	Acetone	lb	6.5% ad val.	20% ad val.
427.62	00	Ethyl methyl ketone	lb	6.5% ad val.	20% ad val.
427.64	00	Other	lb	6.5% ad val.	20% ad val.
		Alcohols, monohydric, unsubstituted:			
427.70	00	Allyl	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.72	00	Amyl	Lb	2.4¢ per lb.	6¢ per lb.
427.74	00	Butyl	Lb	2¢ per lb.	6¢ per lb.
427.82	00	Crotonyl	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
427.84	00	Decyl	Lb	8% ad val.	25% ad val.
427.88	00	Ethyl for nonbeverage purposes	Gal	4.8¢ per gal.	15¢ per gal.
427.92	00	Fusel oil	Lb	2.4¢ per lb.	6¢ per lb.
427.94	00	Hexyl	Lb	2.4¢ per lb.	6¢ per lb.
427.96	00	Methyl	Gal	12.2¢ per gal.	18¢ per gal.
427.98	00	Octyl	Lb	8% ad val.	25% ad val.
428.04	00	Propargyl	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.06	00	Propyl	Lb	2.4¢ per lb.	6¢ per lb.
428.12	00	Other	Lb	8% ad val.	25% ad val.
		Halohydrins:			
428.20	00	Butylene chlorohydrin	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.22	00	Ethylene chlorohydrin	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.24	00	Propylene chlorohydrin	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.26	00	Other	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Alcohols, polyhydric (including glycols, polyglycols, diols, and polyols), and esters, ethers, and ether-esters and substituted derivatives of any of the foregoing:			
428.30	00	Butylene glycol and propylene glycol	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.32	00	Dipentaerythritol and pentaerythritol	Lb	8% ad val.	25% ad val.
428.34	00	Ethylene glycol	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Glycerine:			
428.36	00	Crude	Lb	0.3¢ per lb.	1¢ per lb.
428.38	00	Refined	Lb	0.8¢ per lb.	2¢ per lb.
428.40	00	Glycerine esters and ethers	Lb	8% ad val.	25% ad val.
428.42	00	Polyalcohols, sulfonated	Lb	8% ad val.	25% ad val.
		Other:			
428.44	00	Triols and tetrols	Lb	8% ad val.	25% ad val.
428.46	00	Other	Lb	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty	
				1	2
		Esters of monohydric alcohols and organic or inorganic acids (except hydrogen sulfide and hydrogen halide acids):			
428.50	00	Amyl acetate	Lb.	1.6¢ per lb.	7¢ per lb.
428.52	00	Butyl acetate	Lb.	2.8¢ per lb.	7¢ per lb.
428.54	00	Diethyl sulfate and dimethyl sulfate	Lb.	8% ad val.	25% ad val.
428.58	00	Ethyl acetate	Lb.	1.2¢ per lb.	3¢ per lb.
428.62	00	Ethyl acrylate	Lb.	8% ad val.	25% ad val.
428.64	00	Ethyl methacrylate	Lb.	8% ad val.	25% ad val.
428.66	00	Methyl acrylate	Lb.	8% ad val.	25% ad val.
428.68	00	Vinyl acetate	Lb.	1¢ per lb. + 5% ad val.	6¢ per lb. + 30% ad val.
428.72	00	Other	Lb.	8% ad val.	25% ad val.
		Epoxides and halogenated epoxides:			
428.80	00	Butylene oxide	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.82	00	Epichlorohydrin	Lb.	8% ad val.	25% ad val.
428.84	00	Ethylene oxide	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.86	00	Propylene oxide	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
428.88	00	Other	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Ethers of monohydric alcohols:			
428.90	00	Ethyl	Lb.	1.6¢ per lb.	4¢ per lb.
428.92	00	Isopropyl	Lb.	8% ad val.	25% ad val.
428.94	00	Vinyl	Lb.	2¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
428.96	00	Other	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
429.00	00	Acetals	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
		Lactones:			
429.10	00	Butyrolactone	Lb.	10% ad val.	25% ad val.
429.12	00	Other	Lb.	8% ad val.	25% ad val.
		Halogenated hydrocarbons:			
429.20	00	Butylene dichloride, ethylene dichloride, and propylene dichloride	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
429.22	00	Carbon tetrachloride	Lb.	0.5¢ per lb.	1¢ per lb.
429.24	00	Chloroform	Lb.	3.2¢ per lb.	4¢ per lb.
429.26	00	Ethyl chloride	Lb.	6¢ per lb.	15¢ per lb.
429.28	00	Ethylene dibromide	Lb.	1.9¢ per lb. + 9.5% ad val.	6¢ per lb. + 30% ad val.
429.30	00	Hexachloroethane	Lb.	8% ad val.	25% ad val.
429.32	00	Methylene chloride (dichloromethane)	Lb.	8% ad val.	25% ad val.
429.34	00	Perchloroethylene	Lb.	4.5% ad val.	25% ad val.
429.38	00	Tetrachloroethane	Lb.	12% ad val.	30% ad val.
429.42	00	Trichloroethylene	Lb.	6% ad val.	30% ad val.
429.44	00	Vinyl chloride	Lb.	2¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
429.46	00	Vinylidene chloride	Lb.	2¢ per lb. + 10% ad val.	6¢ per lb. + 30% ad val.
		Other:			
429.47	00	Chlorinated but not otherwise halogenated	Lb.	2.4¢ per lb. + 12% ad val.	6¢ per lb. + 30% ad val.
429.48	00	Other	Lb.	8% ad val.	25% ad val.
		Hydrocarbons:			
429.50	00	Butadiene, butylene, ethylene, and propylene	Gal.	Free	Free
429.52	00	Other	Lb.	8% ad val.	25% ad val.
429.60	00	Sulfur compounds, including thiols, sulfides, sulfoxides, and sulfones	Lb.	8% ad val.	25% ad val.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 2. - Chemical Elements, Inorganic and Organic Compounds, and Mixtures

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty	
				1	2
		Other organic compounds:			
429.70	00	Tetraethyl lead	Lb	15% ad val.	30% ad val.
429.85	00	Tetramethyl lead	Lb	10.5% ad val.	25% ad val.
429.95	00	Other	Lb	8% ad val.	25% ad val.
430.00	00	Mixtures of two or more organic compounds	Lb	8% ad val., but not less than the highest rate applicable to any component compound	25% ad val., but not less than the highest rate applicable to any component compound
		Subpart E. - Chemical Mixtures			
432.00	00	Mixtures not specially provided for	Lb	8% ad val., but not less than the highest rate applicable to any component material	25% ad val., but not less than the highest rate applicable to any component material

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

STAGED RATES AND HISTORICAL NOTES

Notes p. 6
Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
426.64	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.72	6¢ per lb.	5.4¢ per lb.	4.8¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.
426.77	2.5¢ per lb.	2.25¢ per lb.	2¢ per lb.	1.75¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
426.78	14¢ per lb.	12.5¢ per lb.	11.2¢ per lb.	9.8¢ per lb.	8.4¢ per lb.	7¢ per lb.
426.82	5¢ per lb.	4.5¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.	2.5¢ per lb.
426.84	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
426.86	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.88	10% ad val.	9% ad val.	8% ad val.	7.5% ad val.	6.5% ad val.	6% ad val.
426.92	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
426.94	12¢ per lb.	10.8¢ per lb.	9.6¢ per lb.	8.4¢ per lb.	7.2¢ per lb.	6¢ per lb.
426.96	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
426.98	2¢ per lb.	1.8¢ per lb.	1.6¢ per lb.	1.4¢ per lb.	1.2¢ per lb.	1¢ per lb.
427.02	2.5¢ per lb.	2.2¢ per lb.	2¢ per lb.	1.7¢ per lb.	1.5¢ per lb.	1.4¢ per lb.
427.04	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.06	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.08	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.12	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.14	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
427.16	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
427.18	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
427.20	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
427.22	32% ad val.	28.5% ad val.	25.5% ad val.	22% ad val.	19% ad val.	16% ad val.
427.24	35% ad val.	31% ad val.	28% ad val.	24% ad val.	21% ad val.	17.5% ad val.
427.26	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.28	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.30	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.40	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.42	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.44	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.46	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.48	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.50	0.875¢ per lb.	0.78¢ per lb.	0.7¢ per lb.	0.6¢ per lb.	0.52¢ per lb.	0.43¢ per lb.
427.52	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.54	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.56	4¢ per lb.	3.6¢ per lb.	3.2¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2¢ per lb.
427.58	4¢ per lb. + 15% ad val.	3.7¢ per lb. + 13% ad val.	3.4¢ per lb. + 12% ad val.	3.1¢ per lb. + 10% ad val.	2.8¢ per lb. + 9% ad val.	2.5¢ per lb. + 7.5% ad val.
427.60	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.62	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.64	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
427.70	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.72 1/	3¢ per lb.	2.5¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
427.74	2.5¢ per lb.	2.2¢ per lb.	2¢ per lb.	1.7¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
427.82	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
427.84	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
427.88	6¢ per gal.	5.4¢ per gal.	4.8¢ per gal.	4.2¢ per gal.	3.5¢ per gal.	3¢ per gal.
427.92	3¢ per lb.	2.7¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
427.94	3¢ per lb.	2.7¢ per lb.	2.4¢ per lb.	2.1¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
427.96	15.3¢ per gal.	13.7¢ per gal.	12.2¢ per gal.	10.7¢ per gal.	9.1¢ per gal.	7.6¢ per gal.
427.98	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.04	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.

1/ See footnote 1 at the end of this list of Staged Rates.

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STAGED RATES AND HISTORICAL NOTES

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Schedule 4,
Part 2

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
428.06	3¢ per lb.	2.7¢ per lb.	2.4¢ per lb.	2.1¢ per lb.	1.8¢ per lb.	1.5¢ per lb.
428.12	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.20	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.22	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.24	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.26	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.30	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.32	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.34	3¢ per lb + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.5¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.36	0.4¢ per lb.	0.35¢ per lb.	0.3¢ per lb.	0.25¢ per lb.	0.2¢ per lb.	0.2¢ per lb.
428.38	1¢ per lb.	0.9¢ per lb.	0.8¢ per lb.	0.7¢ per lb.	0.6¢ per lb.	0.5¢ per lb.
428.40	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.42	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.44	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.46	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
428.50	2¢ per lb.	1.8¢ per lb.	1.6¢ per lb.	1.4¢ per lb.	1.2¢ per lb.	1¢ per lb.
428.52 1/	3.5¢ per lb.	3¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.7¢ per lb.
428.54	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.58	1.5¢ per lb.	1.35¢ per lb.	1.2¢ per lb.	1.05¢ per lb.	0.9¢ per lb.	0.75¢ per lb.
428.62	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.64	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.66	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.68	1.25¢ per lb. + 6.25% ad val.	1.1¢ per lb. + 5.5% ad val.	1¢ per lb. + 5% ad val.	0.87¢ per lb. + 4% ad val.	0.75¢ per lb. + 3.5% ad val.	0.6¢ per lb. + 3% ad val.
428.72	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.80	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7% ad val.
428.82	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.84	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7% ad val.
428.86	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7% ad val.
428.88	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7% ad val.
428.90	2¢ per lb.	1.8¢ per lb.	1.6¢ per lb.	1.4¢ per lb.	1.2¢ per lb.	1¢ per lb.
428.92	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
428.94	2.5¢ per lb. + 12.5% ad val.	2.2¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.7¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.2¢ per lb. + 6% ad val.
428.96	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
429.00	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
429.10	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
429.12	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.20	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
429.22	0.65¢ per lb.	0.58¢ per lb.	0.5¢ per lb.	0.45¢ per lb.	0.39¢ per lb.	0.32¢ per lb.
429.24	4¢ per lb.	3.6¢ per lb.	3.2¢ per lb.	2.8¢ per lb.	2.4¢ per lb.	2¢ per lb.
429.26 1/	7.5¢ per lb.	6.75¢ per lb.	6¢ per lb.	5.25¢ per lb.	4.5¢ per lb.	3.7¢ per lb.
429.28	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10.8% ad val.	1.9¢ per lb. + 9.5% ad val.	1.6¢ per lb. + 8.4% ad val.	1.4¢ per lb. + 7% ad val.	1.2¢ per lb. + 6% ad val.
429.30	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.32	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.34 1/	6% ad val.	5% ad val.	4.5% ad val.	4% ad val.	3.5% ad val.	3% ad val.
429.38	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.

1/ See footnote 1 at the end of this list of Staged Rates.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

STAGED RATES AND HISTORICAL NOTES

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Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002 (con.):

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
429.42 1/	7.5% ad val.	6.5% ad val.	6% ad val.	5% ad val.	4% ad val.	3.5% ad val.
429.44	2.5¢ per lb. + 12.5% ad val.	2.25¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.75¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.25¢ per lb. + 6% ad val.
429.46	2.5¢ per lb. + 12.5% ad val.	2.25¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.75¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.25¢ per lb. + 6% ad val.
429.47	3¢ per lb. + 15% ad val.	2.7¢ per lb. + 13% ad val.	2.4¢ per lb. + 12% ad val.	2.1¢ per lb. + 10% ad val.	1.8¢ per lb. + 9% ad val.	1.5¢ per lb. + 7.5% ad val.
429.48	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.52	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.60	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
429.95	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
430.00	10.5% ad val., but not less than the highest rate applicable to any component compound	9% ad val., but not less than the highest rate applicable to any component compound	8% ad val., but not less than the highest rate applicable to any component compound	7% ad val., but not less than the highest rate applicable to any component compound	6% ad val., but not less than the highest rate applicable to any component compound	5% ad val., but not less than the highest rate applicable to any component compound
432.00	10.5% ad val., but not less than the highest rate applicable to any component material	9% ad val., but not less than the highest rate applicable to any component material	8% ad val., but not less than the highest rate applicable to any component material	7% ad val., but not less than the highest rate applicable to any component material	6% ad val., but not less than the highest rate applicable to any component material	5% ad val., but not less than the highest rate applicable to any component material

1/ In accordance with general note 3(f) to Schedule XX (Geneva - 1967), the rates of duty for this item in the columns headed 1970, 1971, 1972 will become effective unless the European Economic Community and the United Kingdom do not proceed with certain reductions provided for in their respective schedules annexed to the Geneva (1967) Protocol to the GATT. If these two participants do not so proceed, the President shall so proclaim, and the rate of duty in the column headed 1969 will continue in effect unless or until the President proclaims that they have agreed so to proceed. See related footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, parts 3, 4, 5, 7, 8, 9, and 13; schedule 5, part 1; schedule 6, part 2; and schedule 7, parts 2, 9, 12, and 13.

Other Amendments and Modifications

PROVISION

425.39--Item 425.40 (column 1 rate--10.5% ad val.; column 2 rate--25% ad val.) deleted and items 425.39 and 425.41 and heading immediately preceding item 425.39 added in lieu thereof. Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002, effective date Jan. 1, 1968.

425.41

425.82--Column 1 and 2 rates of duty increased from 12.5% ad val. and 25% ad val., respectively, to 16% ad val. and 35% ad val., respectively. Pub. L. 89-241, Secs. 2[a], 23, Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

426.58--Column 1 rate of duty of 11% ad val. reduced to 10% ad val. on Jan. 1, 1968. General headnote 3(f).

PROVISION

428.50--Language "and organic or inorganic acids (except
428.52 hydrogen sulfide and hydrogen halide acids)" added
428.54 to heading immediately preceding item 428.50. Pub.
428.58 L. 89-241, Secs. 2(a), 23, Oct. 7, 1965, 79 Stat.
428.62 933, 938, effective date Dec. 7, 1965.
428.64
428.66
428.68
428.72

429.80--Item 429.80 (Cellulose compounds: column 1 rate--16¢ per lb.; column 2 rate--45¢ per lb.) deleted. Pub. L. 89-241, Secs. 2(a), 24(a), Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

429.85--Item 429.90 (column 1 rate--10.5% ad val.; column 2
429.90 rate--25% ad val.) deleted and items 429.85 and
429.95 429.95 added in lieu thereof. Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002, effective date Jan. 1, 1968.

Statistical Notes

PROVISION	Effective date	PROVISION	Effective date
416.45--		419.34--	
00--Dias. (transferred to 416.4180 & 40).....	Jan. 1, 1967	00--Total (transferred from 419.3420 & 40)...	Jan. 1, 1968
20--Tolu. (transferred from 416.4400pt).....	do	20--Dias. (transferred to 419.3400).....	do
40--Total	do	40--Tolu.	do

419.13--See Other Amendments and Modifications (item 419.16)
00--Alumina imported for use in producing

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Statistical Notes--(con.)

PROVISION	Effective date
420.32--	
00--Unit of quantity changed from "Lb." to "L. ton" of salt content	Jan. 1, 1964
420.34--	
00--Unit of quantity changed from "Lb." to "L. ton"	Jan. 1, 1964
423.00--	
20--Disc.(transferred to 423.0200)	Jan. 1, 1964
30--Disc.	do
40--Estab.(transferred from 423.0020 & 80)	do
425.04--	
00--Amino acids used as animal feeds and ingredients therefor transferred from 184.7500	Dec. 7, 1965
Disc.(transferred to 425.0420 & 40)	Jan. 1, 1968
20--Estab.(transferred from 425.0400pt)	do
40--Estab.	do
425.10--	
00--Disc.(transferred to 425.1020 & 40)	Jan. 1, 1968
20--Estab.(transferred from 425.1000pt)	do
40--Estab.	do
425.30--See Other Amendments and Modifications	
00--Estab.(transferred from 425.4000pt)	Jan. 1, 1968
425.40--See Other Amendments and Modifications	
00--Disc.(transferred to 425.3900 & 425.4100)	Jan. 1, 1968
425.47--See Other Amendments and Modifications	
00--Estab.(transferred from 425.4000pt)	Jan. 1, 1968

PROVISION	Effective date
425.58--See Other Amendments and Modifications	
425.98--See Amendments and Modifications (Item 907.30)	
426.88--See Other Amendments and Modifications	
428.50--See Other Amendments and Modifications	
428.52--See Other Amendments and Modifications	
428.54--See Other Amendments and Modifications	
428.58--See Other Amendments and Modifications	
428.62--See Other Amendments and Modifications	
428.64--See Other Amendments and Modifications	
428.66--See Other Amendments and Modifications	
428.68--See Other Amendments and Modifications	
428.72--See Other Amendments and Modifications	
429.80--See Other Amendments and Modifications	
00--Disc.(transferred to 465.8700 & 493.1800)	Dec. 7, 1965
429.85--See Other Amendments and Modifications	
00--Estab.(transferred from 429.9000pt)	Jan. 1, 1968
429.90--See Other Amendments and Modifications	
00--Disc.(transferred to 429.8500 & 429.9500)	Jan. 1, 1968
429.95--See Other Amendments and Modifications	
00--Estab.(transferred from 429.9000pt)	Jan. 1, 1968

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Subpart B. - Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products			
		Subpart B headnote:			
		1. For the purposes of this part -- (a) the term "crude", in items 493.02, 493.20, and 493.35, has the same meaning as is given for that term in headnote 3(c) of part 5 of this schedule; and (b) the term "advanced" in items 493.04, 493.21, and 493.36, has the same meaning as is given for that term in headnote 3(d) in part 5 of this schedule.			
		Barbasco or cube root, and derris, tube or tuba root:			
493.02	00	Crude	Lb.	Free	Free
493.04	00	Advanced	Lb.	0.5% ad val.	10% ad val.
493.10	00	Blackings, powders, liquids, and creams for polishing and cleaning, all the foregoing in immediate containers holding not over 10 pounds each	X	4.8% ad val.	45% ad val.
		Casein and mixtures in chief value thereof:			
493.15	00	Casein	Lb.	Free	Free
493.16	00	Other	Lb.	2¢ per lb.	5.5¢ per lb.
493.18	00	Cellulose compounds, not specially provided for	Lb.	12.5¢ per lb.	45¢ per lb.
		Camphor:			
		Natural:			
493.20	00	Crude	Lb.	0.4¢ per lb.	1¢ per lb.
493.21	00	Advanced	Lb.	2.4¢ per lb.	5¢ per lb.
493.22	00	Synthetic	Lb.	4¢ per lb.	8¢ per lb.
		Chars and carbons:			
493.25	00	Bone char	Lb.	16% ad val.	20% ad val.
493.26	00	Decolorizing and gas or vapor absorbing chars and carbons, whether or not activated	Lb.	12% ad val.	45% ad val.
493.30	00	Dextrins and soluble or chemically treated starches	Lb.	1.125¢ per lb. 1/	3¢ per lb.
493.35	00	Fibrin	Lb.	Free	Free
493.40	00	Mineral salts obtained by evaporation from the waters of a designated mineral spring	Lb.	Free	Free
493.42	00	Preparations containing over 50 percent by weight of monosodium glutamate	X	16% ad val.	25% ad val.
		Pitch:			
493.45	00	Burgundy	Lb.	Free	Free
493.46	00	Marine glue	Lb.	12.5% ad val	20% ad val.
493.47	00	Wood	Lb.	0.4¢ per lb.	1¢ per lb.
493.50	00	Products chiefly used as assistants in preparing or finishing textiles, not specially provided for	Lb.	10% ad val.	25% ad val.
		Pyrethrum or insect flowers:			
493.55	00	Crude	Lb.	Free	Free
493.56	00	Advanced	Lb.	1% ad val.	10% ad val.

1/ Rate temporarily increased by proclamation. See Appendix to Tariff Schedules.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

STAGED RATES AND HISTORICAL NOTES

Notes p. 1
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Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002:

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
490.10	3¢ per lb. + 10% ad val.	2.7¢ per lb. + 9% ad val.	2.4¢ per lb. + 8% ad val.	2¢ per lb. + 7% ad val.	1.8¢ per lb. + 6% ad val.	1.5¢ per lb. + 5% ad val.
490.12	3¢ per lb. + 12.5% ad val.	2.7¢ per lb. + 11% ad val.	2.4¢ per lb. + 10% ad val.	2.1¢ per lb. + 8.5% ad val.	1.9¢ per lb. + 7% ad val.	1.5¢ per lb. + 6% ad val.
490.14	1.5¢ per lb. + 10% ad val.	1.3¢ per lb. + 9% ad val.	1.2¢ per lb. + 8% ad val.	1¢ per lb. + 7% ad val.	0.9¢ per lb. + 6% ad val.	0.7¢ per lb. + 6% ad val.
490.20	4.5¢ per lb. + 10% ad val.	4¢ per lb. + 9% ad val.	3.5¢ per lb. + 8% ad val.	3¢ per lb. + 7% ad val.	2.5¢ per lb. + 6% ad val.	2.2¢ per lb. + 5% ad val.
490.22	2.25¢ per lb. + 10% ad val.	2¢ per lb. + 9% ad val.	1.8¢ per lb. + 8% ad val.	1.5¢ per lb. + 7% ad val.	1.3¢ per lb. + 6% ad val.	1.1¢ per lb. + 5% ad val.
490.24	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.26	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.30	1.5¢ per lb. + 10% ad val.	1.3¢ per lb. + 9% ad val.	1.2¢ per lb. + 8% ad val.	1¢ per lb. + 7% ad val.	0.9¢ per lb. + 6% ad val.	0.7¢ per lb. + 5% ad val.
490.32	1.5¢ per lb. + 10% ad val.	1.3¢ per lb. + 9% ad val.	1.2¢ per lb. + 8% ad val.	1¢ per lb. + 7% ad val.	0.9¢ per lb. + 6% ad val.	0.7¢ per lb. + 5% ad val.
490.40	7.25¢ per lb.	6.5¢ per lb.	5.8¢ per lb.	5¢ per lb.	4.3¢ per lb.	3.6¢ per lb.
490.42	2.25¢ per lb. + 15% ad val.	2¢ per lb. + 13.5% ad val.	1.8¢ per lb. + 12% ad val.	1.5¢ per lb. + 10.5% ad val.	1.3¢ per lb. + 9% ad val.	1¢ per lb. + 7.5% ad val.
490.44	2.25¢ per lb. + 10% ad val.	2¢ per lb. + 9% ad val.	1.8¢ per lb. + 8% ad val.	1.5¢ per lb. + 7% ad val.	1.3¢ per lb. + 6% ad val.	1.1¢ per lb. + 5% ad val.
490.46	2.25¢ per lb. + 10% ad val.	2¢ per lb. + 9% ad val.	1.8¢ per lb. + 8% ad val.	1.5¢ per lb. + 7% ad val.	1.3¢ per lb. + 6% ad val.	1¢ per lb. + 5% ad val.
490.48	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.50	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.65	2.5¢ per lb. + 12.5% ad val.	2.2¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.7¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.2¢ per lb. + 6% ad val.
490.71	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.75	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.90	0.75¢ per lb. + 10.5% ad val.	0.65¢ per lb. + 9% ad val.	0.6¢ per lb. + 8% ad val.	0.5¢ per lb. + 7% ad val.	0.4¢ per lb. + 6% ad val.	0.3¢ per lb. + 5% ad val.
490.93	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
490.94	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
491.00	10.5% ad val., but not less than the highest rate applicable to any component	9% ad val., but not less than the highest rate applicable to any component	8% ad val., but not less than the highest rate applicable to any component	7% ad val., but not less than the highest rate applicable to any component	6% ad val., but not less than the highest rate applicable to any component	5% ad val., but not less than the highest rate applicable to any component
493.04	1% ad val.	0.5% ad val.	0.5% ad val.	Free	Free	Free
493.10	6% ad val.	5% ad val.	4.5% ad val.	4% ad val.	3.5% ad val.	3% ad val.
493.16	2.75¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.8¢ per lb.	1.5¢ per lb.	1.3¢ per lb.
493.18	16¢ per lb.	14.4¢ per lb.	12.5¢ per lb.	11¢ per lb.	9.5¢ per lb.	8¢ per lb.
493.20 1/	0.6¢ per lb.	0.4¢ per lb.	0.4¢ per lb.	0.4¢ per lb.	0.2¢ per lb.	0.2¢ per lb.
493.24 1/	3¢ per lb.	2.5¢ per lb.	2.4¢ per lb.	2¢ per lb.	1.5¢ per lb.	1.5¢ per lb.
493.28	4¢ per lb.	3.5¢ per lb.	3¢ per lb.	2.5¢ per lb.	2¢ per lb.	2.5¢ per lb.
493.28	20% ad val.	18% ad val.	16% ad val.	14% ad val.	12% ad val.	10% ad val.
493.36	15% ad val.	13% ad val.	12% ad val.	10% ad val.	9% ad val.	7.5% ad val.
493.40	16% ad val.	14% ad val.	12.5% ad val.	11% ad val.	9.5% ad val.	8% ad val.
493.42 1/	0.5¢ per lb.	0.45¢ per lb.	0.4¢ per lb.	0.35¢ per lb.	0.3¢ per lb.	0.25¢ per lb.
493.50	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
493.52	2.5% ad val.	1% ad val.	1% ad val.	1% ad val.	Free	Free
493.60	20% ad val.	18% ad val.	16% ad val.	14% ad val.	12% ad val.	10% ad val.
493.66	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
493.67	17.5% ad val.	15.5% ad val.	14% ad val.	12% ad val.	10% ad val.	8.5% ad val.
493.68	20% ad val.	18% ad val.	16% ad val.	14% ad val.	12% ad val.	10% ad val.
493.69	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.

1/ See footnote 1 at the end of this list of Staged Rates.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1969)

STAGED RATES AND HISTORICAL NOTES

Notes p. 2
Schedule 4,
Part 13

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19001 (con.)]

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 ---				
		1968	1969	1970	1971	1972
494.04	15% ad val.	13% ad val.	12% ad val.	10% ad val.	8% ad val.	7.5% ad val.
494.06	2.5¢ per lb.	2.3¢ per lb.	2¢ per lb.	1.7¢ per lb.	1.5¢ per lb.	1.2¢ per lb.
494.22	0.5¢ per lb.	0.4¢ per lb.	0.3¢ per lb.	0.2¢ per lb.	0.1¢ per lb.	Free
494.52	10.5% ad val	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
494.60	5% ad val.	4% ad val.	4% ad val.	4% ad val.	3% ad val.	2.5% ad val.
495.05 1/	8% ad val.	7% ad val.	6% ad val.	5.5% ad val.	4.5% ad val.	4% ad val.
495.10	17.5% ad val.	15.5% ad val.	14% ad val.	12% ad val.	10% ad val.	8.5% ad val.
495.15 1/	5% ad val.	4% ad val.	4% ad val.	3% ad val.	3% ad val.	2.5% ad val.
495.20	20% ad val.	18% ad val.	16% ad val.	14% ad val.	12% ad val.	10% ad val.

1/ See footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, part 7.

Other Amendments and Modifications

PROVISION
Subpt A--Headnote 1 deleted. Pub. L. 89-388, Secs. 1(f)(3), Note 1 2, April 13, 1966, 80 Stat. 110, effective date April 13, 1966.
490.24--Rates of duty for items 490.24 (column 1--3¢ per 490.48 lb. + 10% ad val.; column 2--3¢ per lb. + 20% ad 490.72 val.), 490.48 (column 1--3¢ per lb. + 10% ad val., column 2--3¢ per lb. + 25% ad val.), and 490.72 (column 1--3¢ per lb. + 10.5% ad val.; column 2--3¢ per lb. + 25% ad val.) reduced by 3¢ per lb. Pub. L. 89-388, Secs. 1(e)(2), 2, April 13, 1966, 80 Stat. 110, effective date April 13, 1966. The rates of duty for these items had been temporarily reduced by 3¢ per lb. by former items 907.85, 907.86, and 907.87.

PROVISION
490.92--Rates of duty for item 490.92 (column 1--1.5¢ per lb. + 10.5% ad val.; column 2--1.5¢ per lb. + 25% ad val.) reduced by 1.5¢ per lb. Pub. L. 89-388, Secs. 1(e)(5), 2, April 13, 1966, 80 Stat. 110, effective date April 13, 1966. The rates of duty for this item had been temporarily reduced by 1.5¢ per lb. by former item 907.88.
493.18--Item 493.18 added. Pub. L. 89-241, Secs. 2(a), 24(d), Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

Statistical Notes

PROVISION	Effective date
490.14--	
00--Estab.(transferred from 490.1480 & 40)....Jan. 1, 1968	
20--Disc.(transferred to 490.1400).....	do
40--Disc. do	do
490.24--See Other Amendments and Modifications	
00--Estab.(transferred from 490.2420 & 40)....Jan. 1, 1968	
20--Disc.(transferred to 490.2400).....	do
40--Disc. do	do
490.36--	
00--Estab.(transferred from 490.3620 & 40)....Jan. 1, 1968	
20--Disc.(transferred to 490.3600).....	do
40--Disc. do	do

PROVISION	Effective date
490.48--See Other Amendments and Modifications	
490.72--See Other Amendments and Modifications	
490.92--See Other Amendments and Modifications	
493.18--See Other Amendments and Modifications	
00--Estab.(transferred from 429.8000pt).....Dec. 7, 1965	
493.30--See Amendments and Modifications (item 949.43)	
494.50--	
00--Disc.(transferred to 494.5020 & 40).....Jan. 1, 1968	
20--Estab.(transferred from 434.4000pt).....	do
40--Estab. do	do

A P P E N D I X B

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1967.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1967

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1967	Percent change from 1966	Country	Value	Country	Value	Country	Value
Butyl alcohol (p. 3)								
427.74	51	+1,804	U King	51	-	-	-	-
Decyl alcohol (p. 11)								
427.84	888	+25	France	383	U King	238	Japan	163
Ethyl alcohol for nonbeverage purposes (p. 17)								
427.88	2,420	-41	Brazil	1,976	Peru	444	-	-
Methyl alcohol (p. 25)								
427.96	377	-87	Japan	272	Italy	95	Canada	10
Octyl alcohol (p. 33)								
427.98	467	-65	U King	358	France	109	-	-
Propyl alcohol (p. 39)								
428.06	76	+2,049	Netherlands	65	Canada	11	-	-
Alcohols, monohydric, unsubstituted, not elsewhere enumerated (p. 45)								
427.70	5	-84	W Germ	5	-	-	-	-
427.72	22	+47	U King	17	France	5	-	-
427.82	5	1/	W Germ	5	-	-	-	-
427.92	-	1/	-	-	-	-	-	-
427.94	16	+106	W Germ	16	-	-	-	-
428.04	58	+147	W Germ	58	-	-	-	-
428.12	1,949	+97	W Germ	1,219	U King	494	France	219
Halohydrins (p. 51)								
428.20	3	1/	Canada	3	-	-	-	-
428.22	5	-63	U King	5	-	-	-	-
428.24	-	1/ 2/	-	-	-	-	-	-
428.26	5	+386	W Germ	5	-	-	-	-
Butylene glycol and propylene glycol (p. 65)								
428.30	10	-99	W Germ	9	U King	1	-	-
Dipentaerythritol and pentaerythritol (p. 69)								
428.32	1,129	-45	Japan	725	Italy	307	W Germ	49
Ethylene glycol (p. 73)								
428.34	40	-35	Switzerland	19	Japan	18	Netherlands	1
Glycerine (p. 77)								
428.36	357	-40	Phil R	311	Netherlands	26	Canada	12
428.38	328	+54	Netherlands	134	U King	105	Italy	25

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1967--Continued

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1967	Percent change from 1966	Country	Value	Country	Value	Country	Value
Glycerine esters and ethers (p. 85)								
428.40	30	-58	Canada	30	-	-	-	-
Polyhydric alcohols and derivatives, not elsewhere enumerated (p. 89)								
428.42	1	1/	U King	1	-	-	-	-
428.44	174	+598	Japan	150	W Germ	16	Switzerland	8
428.46	5,655	+170	Canada	4,449	W Germ	1,134	Switzerland	29
Amyl acetate (p. 97)								
428.50	2/	1/	-	-	-	-	-	-
Butyl acetate (p. 101)								
428.52	3	+955	Japan	3	-	-	-	-
Ethyl acetate (p. 107)								
428.58	158	-40	Japan	80	Canada	78	-	-
Vinyl acetate (p. 111)								
428.68	3,491	+11	Canada	3,327	Japan	164	-	-
Esters of monohydric alcohols and organic and inorganic acids, not elsewhere enumerated (p. 115)								
428.54	18	-15	U King	18	-	-	-	-
428.62	2/	-100	-	-	-	-	-	-
428.64	2/	1/	-	-	-	-	-	-
428.66	2/	-100	-	-	-	-	-	-
428.72	3,149	-14	W Germ	1,206	Switzerland	637	Netherlands	565
Butylene oxide, epichlorohydrin, and epoxides not elsewhere enumerated (p. 129)								
428.80	166	1/	W Germ	165	Japan	1	-	-
428.82	2/	1/	-	-	-	-	-	-
428.88	499	-62	W Germ	497	Netherlands	2	-	-
Ethylene oxide (p. 121)								
428.84	175	+311	Canada	157	W Germ	17	Netherlands	1
Propylene oxide (p. 125)								
428.86	63	+1,437	Canada	63	-	-	-	-
Ethers of monohydric alcohols, and acetals (p. 133)								
428.90	6	1/	Sweden	6	-	-	-	-
428.92	2/	1/	-	-	-	-	-	-
428.94	65	-26	W Germ	50	Japan	15	-	-
428.96	29	-85	W Germ	18	Canada	5	U King	5
429.00	7	-90	W Germ	6	Switzerland	1	-	-

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1967--Continued

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1967	Percent change from 1966	Country	Value	Country	Value	Country	Value
Lactones (p. 141)								
429.10	173	-73	W Germ	172	U King	1	-	-
429.12	47	-83	Switzerland	41	W Germ	3	Japan	2
Butylene dichloride, ethylene dichloride, and propylene dichloride (p. 159)								
429.20	4	+1,069	U King	4	-	-	-	-
Carbon tetrachloride (p. 163)								
429.22	226	-54	W Germ	216	Italy	9	Japan	1
Chloroform (p. 169)								
429.24	2/	-100	-	-	-	-	-	-
Ethyl chloride (p. 173)								
429.26	4	+83	W Germ	4	-	-	-	-
Ethylene dibromide (p. 177)								
429.28	34	-75	Israel	34	-	-	-	-
Methylene chloride (p. 181)								
429.32	650	-24	W Germ	311	Italy	279	Belgium	51
Perchloroethylene (p. 185)								
429.34	3,410	-24	France	1,600	Italy	592	W Germ	264
Trichlorethylene (p. 189)								
429.42	5,952	-23	Italy	2,505	France	1,061	U King	914
Vinyl chloride and vinylidene chloride (p. 193)								
429.44	101	-84	Canada	99	Sweden	2	Italy	3/
429.46	48	-33	W Germ	48	-	-	-	-
Hexachloroethane, tetrachloroethane, and other chlorinated hydrocarbons, not elsewhere enumerated (p. 197)								
429.30	263	+41	France	120	Spain	59	U King	46
429.38	2/	1/	-	-	-	-	-	-
429.47	34	-78	Japan	18	U King	11	Canada	3
Fluorinated, brominated, and iodinated hydrocarbons, not elsewhere enumerated (p. 205)								
429.48	1,020	+1	U King	745	France	77	W Germ	72
Hydrocarbons (p. 211)								
429.50	2,715	+3	Canada	2,715	-	-	-	-
429.52	970	+95	Norway	302	France	255	Trinid	232

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1967--Continued

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1967	All countries: Percent change from 1966	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Sulfur compounds, including thiols, sulfides, sulfoxides, and sulfones (p. 217)								
429.60	1,046	-40	U King	625	Netherlands	323	Canada	41
Tetraethyl and tetramethyl lead (p. 223)								
429.70	2/	1/	-	-	-	-	-	-
429.85	2/	1/	-	-	-	-	-	-
Cellulose compounds, not specially provided for (p. 227)								
493.18	333	+25	U King	140	W Germ	131	Sweden	52
Organic compounds, not elsewhere enumerated (p. 233)								
429.90 (429.95-1968)	3,216	+16	Japan	1,227	Netherlands	624	Switzerland	512
Mixtures of two or more organic compounds (p. 239)								
430.00	1,503	+125	Canada	705	W Germ	435	Sweden	145
Mixtures not specially provided for (p. 243)								
432.00	1,527	+20	W Germ	614	Switzerland	205	Canada	188

1/ No imports reported for 1966.
2/ No imports reported for 1967.
3/ Less than $500.

A P P E N D I X C

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1968.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1968

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1968	All countries: Percent change from 1967	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Butylalcohol (p. 3)								
427.74	17	-67	W Germ	17	-	-	-	-
Decyl alcohol (p. 11)								
427.84	669	-25	U King	319	France	197	Japan	153
Ethyl alcohol for non-beverage purposes (p. 17)								
427.88	1/	-100	W Germ	1/	-	-	-	-
Methyl alcohol (p. 25)								
427.96	108	-71	Canada	108	-	-	-	-
Octyl alcohol (p. 33)								
427.98	1,280	+174	W Germ	935	Italy	340	Japan	5
Propyl alcohol (p. 39)								
428.06	2/	-100	-	-	-	-	-	-
Alcohols, monohydric, unsubstituted, not elsewhere enumerated (p. 45)								
427.70	2/	-100	-	-	-	-	-	-
427.72	14	-34	U King	14	-	-	-	-
427.82	2/	-100	-	-	-	-	-	-
427.92	3	3/	Canada	3	-	-	-	-
427.94	1	-96	Netherlands	1	-	-	-	-
428.04	54	-7	W Germ	54	-	-	-	-
428.12	1,750	-10	W Germ	1,063	France	484	Switzld	53
Halohydrins (p. 51)								
428.20	2/	-100	-	-	-	-	-	-
428.22	8	+63	U King	-	-	-	-	-
428.24	2/	2/ 3/	-	-	-	-	-	-
428.26	1	-74	U King	1	-	-	-	-
Butylene glycol and propylene glycol (p. 65)								
428.30	68	+590	W Germ	65	Canada	2	Netherlands	1
Dipentaerythritol and pentaerythritol (p. 69)								
428.32	1,380	+22	Japan	924	Canada	283	Italy	124
Ethylene glycol (p. 73)								
428.34	123	+205	U King	121	W Germ	1	Canada	1/
Glycerine (p. 77)								
428.36	91	-74	Phil R	91	Japan	1/	-	-
428.38	1/	-100	Brazil	1/	-	-	-	-
Glycerine esters and ethers (p. 85)								
428.40	47	+57	Sweden	47	-	-	-	-
Polyhydric alcohols and derivatives, not elsewhere enumerated (p. 89)								
428.42	2/	-100	-	-	-	-	-	-
428.44	37	-79	W Germ	32	Switzld	3	U King	1
428.46	3,946	-30	Canada	3,604	France	91	W Germ	87

See footnotes at end of table.

APPENDIX C

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1968--Continued

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1968	Percent change from 1967	Country	Value	Country	Value	Country	Value
Amyl acetate (p. 97)								
428.50	4	3/	Canada	4	-	-	-	-
Butyl acetate (p. 101)								
428.52	2/	-100	-	-	-	-	-	-
Ethyl acetate (p. 107)								
428.58	201	+27	Canada	105	Japan	95	W Germ	1/
Vinyl acetate (p. 111)								
428.68	4,191	+20	Canada	4,164	Japan	27	-	-
Esters of monohydric alcohols and organic and inorganic acids, not elsewhere enumerated (p. 115)								
428.54	35	+92	U King	31	W Germ	3	Japan	1
428.62	527	3/	Japan	396	France	131	-	-
428.64	10	3/	Japan	10	-	-	-	-
428.66	8	3/	Japan	7	U King	1	-	-
428.72	4,024	+28	W Germ	1,671	Netherlands	982	Switzld	411
Butylene oxide, epichlorohydrin, and epoxides not elsewhere enumerated (p. 129)								
428.80	1/	-100	W Germ	1/	-	-	-	-
428.82	2/	2/ 3/	-	-	-	-	-	-
428.88	32	-94	Japan	29	Norway	3	-	-
Ethylene oxide (p. 121)								
428.84	81	-54	Canada	71	W Germ	9	France	1
Propylene oxide (p. 125)								
428.86	36	-43	Canada	36	-	-	-	-
Ethers of monohydric alcohols, and acetals (p. 133)								
428.90	2	-61	Japan	2	-	-	-	-
428.92	1	3/	W Germ	1	-	-	-	-
428.94	45	-30	W Germ	37	Japan	8	-	-
428.96	67	+134	Canada	63	W Germ	3	Switzld	1
429.00	4	-50	W Germ	3	Switzld	1	Rep SAF	1/
Lactones (p. 141)								
429.10	38	-78	W Germ	38	-	-	-	-
429.12	289	+509	W Germ	178	U King	57	Switzld	43
Butylene dichloride, ethylene dichloride, and propylene dichloride (p. 159)								
429.20	2/	-100	-	-	-	-	-	-
Carbon tetrachloride (p. 163)								
429.22	199	-12	W Germ	84	Canada	65	Italy	49
Chloroform (p. 169)								
429.24	2/	2/ 3/	-	-	-	-	-	-
Ethyl chloride (p. 173)								
429.26	3	-29	W Germ	3	-	-	-	-

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1968--Continued

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1968	Percent change from 1967	Country	Value	Country	Value	Country	Value
Ethylene dibromide (p. 177)								
429.28	1	-97	W Germ	1	Israel	1/	-	-
Methylene chloride (p. 181)								
429.32	856	+32	W Germ	411	Italy	331	Belgium	94
Perchloroethylene (p. 185)								
429.34	2,940	-23	France	996	Canada	764	Italy	758
Trichloroethylene (p. 189)								
429.42	3,180	-47	Italy	1,738	France	537	W Germ	383
Vinyl chloride and vinylidene chloride (p. 193)								
429.44	13	-87	Sweden	9	Japan	2	Netherlands	1
429.46	59	+23	Netherlands	59	-	-	-	-
Hexachloroethane, tetrachloroethane, and other chlorinated hydrocarbons, not elsewhere enumerated (p. 197)								
429.30	206	-22	U King	70	France	59	Spain	44
429.38	2/	2/ 3/	-	-	-	-	-	-
429.47	57	+65	Japan	36	W Germ	15	U King	6
Fluorinated brominated, and iodinated hydrocarbons, not elsewhere enumerated (p. 205)								
429.48	2,934	+188	Canada	1,355	U King	1,138	W Germ	215
Hydrocarbons (p. 211)								
429.50	7,776	+186	Canada	4,471	Argentina	1,147	France	973
429.52	1,491	+54	Trinidad	457	Netherlands	397	France	221
Sulfur compounds including thiols, sulfides, sulfoxides, and sulfones (p. 217)								
429.60	391	-63	U King	224	Canada	72	W Germ	55
Tetraethyl and tetramethyl lead (p. 223)								
429.70	2/	2/ 3/	-	-	-	-	-	-
429.85	2/	2/ 3/	-	-	-	-	-	-
Cellulose compounds not specially provided for (p. 227)								
493.18	454	+36	W Germ	204	U King	163	Sweden	68
Organic compounds, not elsewhere enumerated (p. 233)								
429.95	3,795	+18	Japan	1,530	U King	905	Switzld	357
Mixtures of two or more organic compounds (p. 239)								
430.00	1,473	-2	W Germ	540	Canada	377	Sweden	177
Mixtures not specially provided for (p. 243)								
432.00	932	-39	U King	298	W Germ	258	Canada	236

1/ Less than $500.
2/ No imports reporred for 1968.
3/ No imports reported for 1967.

OTHER AVAILABLE VOLUMES OF THE SUMMARIES SERIES

Schedule	*Volume*	*Title*
1	1	Animals and Meats
1	2	Fish: Fresh, Chilled, Frozen, or Cured
1	3	Fish Products, Shellfish, and Shellfish Products
1	4	Dairy Products and Birds' Eggs
1	5	Live Plants and Seeds
1	6	Cereal Grains, Malts, Starches, and Animal Feeds
1	7	Vegetables and Edible Nuts
1	11	Tobacco and Tobacco Products
1	12	Animal and Vegetable Fats and Oils
1	13	Hides, Skins, Leather, Feathers, and Miscellaneous Articles of Animal Origin
2	1	Wood and Related Products I
2	2	Wood and Related Products II
2	3	Paper and Related Products I
3	5	Textile Furnishings and Apparel
3	6	Cordage, Braids, Elastic Yarns and Fabrics, Trimmings, Packing, Polishing Cloths, Sacks, Labels, Lacings, Rags, and Other Miscellaneous Textile Products
4	2	Inorganic Chemicals I
4	3	Inorganic Chemicals II
4	4	Inorganic Chemicals III
4	9	Glue, Gelatin, Aromatic Substances, Toilet Preparations, Surface-Active Agents, Soaps, Dyes, and Tannins
4	10	Pigments, Inks, Paints, and Related Products
4	12	Fatty Substances, Waxes, and Miscellaneous Chemical Products

OTHER AVAILABLE VOLUMES OF THE SUMMARIES SERIES

Schedule	*Volume*	*Title*
5	2	Gems, Gemstones, Industrial Diamonds, Clays, Fluorspar, Talc, and Miscellaneous Nonmetallic Minerals and Products Thereof
5	4	Pressed and Blown Glassware
6	1	Nonferrous Metals I
6	4	Iron and Steel
6	5	Containers, Wire Products, Foil, Fasteners, and Specified Hardware
6	6	Hand Tools, Cutlery, Forks, and Spoons
6	10	Certain Electrical Appliances, Special-Industry Machinery, Machine Parts, and Electrical Apparatus
7	3	Photographic Equipment and Supplies, Recordings, and Musical Instruments
7	4	Arms and Ammunition; Fishing Tackle; Wheel Goods; Sporting Goods; Toys and Games
7	5	Furniture, Buttons, and other Fastening Devices, Brooms, Brushes, Umbrellas, Canes, and Clothespins
7	6	Jewelry and Related Articles, Decorative Materials, Combs, Smokers' Articles, Pens, Pencils, Works of Art, and Antiques
7	7	Rubber and Plastics Products
7	8	Pyrotechnics and Products Not Elsewhere Enumerated